

MOBILITY INDIA

National Conference on Assistive Technology for All 2030

August 2-3, 2019, Bengaluru, INDIA

Conference Proceedings



National Conference on Assistive Technology for All 2030

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Ritu Ghosh and Lakshmi Raman (Eds.)

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Foreword



Mobility India's 25 years has been an amazing journey in the services of a development sector that is striving to become truly inclusive, especially for the well-being of India's most vulnerable populations, persons with disabilities, older people and people living with chronic conditions and living in poverty. It has always been Mobility India's guiding principle to be at the forefront in the development of innovative and customized solutions to assistive technology for improved access and functional independence of people, especially for persons with disabilities. We are glad that we have been able to do this for the past 25 years.

The National Conference on Assistive Technology for All – 2030 was held in Bangalore on August 2 – 3, 2019 on the eve of MI's Silver Jubilee Celebrations. The conference theme emerges from the UN 2030 Agenda for Sustainable Development Goals, in particular, Goal 3: Good Health and Well-Being, Goal 5: Gender Equality and Goal 10: Reduced Inequalities. This is especially with regard to Goal 3, which places good health and well-being for people of all ages as the centre of a new development vision. Organizing such an event at this point in time reinforces two of our key objectives of innovation and improving access to assistive technology (AT). Sometimes the challenges seem overwhelming, but we all are coming together because it is in bringing together our energies and ideas that we can surmount all the challenges that lie before us in enabling persons with disabilities (PWDs) and elders have a better quality of life.

Today only one in ten people in need have access to essential assistive technology (AT). Most persons with disabilities and their families are excluded, locked into poverty and isolated by the intersectionality of their oppression and lack of access. Assistive products can transform an individual's life, as well as that of families and entire communities. Without it, the impact of disease and disability on the person, his/her family and society is heightened. People thus affected are being denied a fundamental human right. In India, the legal framework for the protection of human rights of PWDs has been strengthened with the Rights of Persons with Disabilities Act 2016. However, the enforcement of its provisions needs to be strengthened with the active synergy of government with public, private and social sectors – local, national and global.

This National Conference on AT was conceived as a forum for knowledge sharing and learning about innovative digital technologies, to dialogue on ideas and solutions which will enable AT reach the most unreached of populations and to achieve the mission health and wellbeing for all.

My gratitude to NIEPMD and ICRC-New Delhi for their collaboration; and to Rehamo, a leading mobility equipment supplier in Bangalore for their sponsorship. I am thankful for Ministry and WHO officials, grateful to all the distinguished guests from within India and abroad, experts, professionals and communities of practice, disabled activists and caregivers of PWDs, and delegates who have helped to make the conference a success. I am also thankful to the many well-wishers who have held MI in their hearts and minds and sent in messages of goodwill and hope. My thanks to the print and electronic media who covered the event. To NIMHANS who provided the venue for the event goes my grateful thanks.

I tender my deep gratitude to the Board of MI, to the founder Mr. Chapal Khasnabis, and the MI team who worked tirelessly behind the scenes to make the conference a success. It is a team that has taken MI from strength to strength over the past 25 years, and are its hope for the next 25 to deliver where it matters most, and make the world a better place to live in with dignity.

Ms. Albina Shankar
Executive Director-Mobility India

Preface

The developments in various transforming technologies of the last two and a half decades could not have been made possible without the networking and coming together of different stakeholders from domains of medicine, engineering, design, academics and research, policy formulation, donors and investors. We have endeavoured to attempt the same with the National Conference on Assistive Technology (AT) for All-2030 held at Bengaluru from 2nd – 3rd August 2019, the first of its kind event in India.



Distinguished speakers and delegates to the Conference on AT came from ministries of the government, business and industry, health and rehabilitation, engineering technology, design and architecture, academia, local and global donors, service users and their caregivers, and interested individuals. This was possible because of the willingness in all of them to dialogue on the common challenges and opportunities before society; and to explore how AT and assistive devices can dramatically improve the quality of life of PWDs, ageing populations and their caregivers.

I am glad that the conference happened at this juncture – the 25th anniversary of Mobility India (MI). It was a huge collective effort by the MI team from practically the end of 2018, although the germ of the idea started 2 years earlier with WHO's GATE initiative. Experts and decision makers, disability activists, students and professionals came when we invited them 'to dialogue on AT and what it means for us today'. The effort involved in this process was enormous, even daunting because of the umbrella theme of the conference. However, it appears that the climate was more than ready for a dialogue of this kind. Invaluable support was provided by MI founder Mr. Chapal Khasnabis of WHO-Geneva with whose inspiration and direction this was made possible.

The Rehabilitation Council of India, the primary accreditation body for professional education in rehabilitation in the country, honoured us by accrediting the conference. The National Institute for Empowerment of Persons with Multiple Disabilities (NIEPMD) with who our collegial relationship has deepened, stepped in to collaborate with MI.

The conference was graced with 27 distinguished speakers and experts in the field from WHO-SEARO, Ministry of SJ&E and the National Institutes, the IITs, IISc, Global Disability Innovation Hub, BIRAC, DEBEL, BeTIC, professional bodies, National Institute of Design, industry and NGOs. The 536 delegates to the conference came from 27 Indian states and 17 countries. The conference would not have been as vibrant as it was without their presence and participation. On our invitation, students from 4 physiotherapy colleges and 2 city schools visited the exhibition held at the conference venue. Thus, over 2,000 individuals gained exposure to AT and information on cutting edge AT devices.

My thanks to the members of NIEPMD for their support through the conference, and to Skyline, Bangalore for making the conference arrangements. Also, thanks to the three sign language interpreters who enabled better participation of PWDs in the conference. To the members of the scientific and technical programme team and other committees who helped to prepare, facilitate and see the conference through to fruition, I cannot fully express my gratitude.

Ritu Ghosh
Scientific Program Chair -AT Conference
Academic Director-Mobility India

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ACRONYMS

AI	:	Artificial Intelligence
AT	:	Assistive Technology
ATscale	:	Global Partnership for Assistive Technology
AWWD	:	Association for Women with Disabilities
BBH	:	Bangalore Baptist Hospital
BeTIC	:	Biomedical Engineering and Technology (Incubation) Center
BIRAC	:	Biotechnology Industry Research Assistance Council
CSO	:	Civil Society Organisation
DPO	:	Disabled Peoples' Organisation
GATE	:	Global Cooperation on Assistive Technology
GBAT	:	Gaze-based assistive technology
GDIH	:	Global Disability Innovation Hub
IAAT	:	Indian Association of Assistive Technologists
ICRC	:	International Committee of the Red Cross
IAP	:	Indian Association of Physiotherapists
INGO	:	International Non-Governmental Organisation
IISc	:	Indian Institute of Science, Bangalore
IIT	:	Indian Institute of Technology
ISPO	:	International Society for Prosthetics and Orthotics
ISWP	:	International Society of Wheelchair Professionals
MI	:	Mobility India
MSJ&E	:	Ministry for Social Justice & Empowerment
NIEPMD	:	National institute for Empowerment of Persons with Multiple Disabilities
NIRTAR	:	Swami Vivekananda National institute for Rehabilitation Training and Research
NGO	:	Non-Governmental Organisation
PDUIPH	:	Pandit Deendayal Institute for the Physically Handicapped
P&O	:	Prosthetics & Orthotics
PWD	:	Persons with Disability
RCI	:	Rehabilitation Council of India
RGUHS	:	Rajiv Gandhi University of Health Sciences, Karnataka
RPDW Act	:	Rights of Persons with Disabilities Act 2016
TN	:	Tamilnadu
UHC	:	Universal Health Coverage
WHO-SEARO	:	World Health Organisation- South East Asia Regional office
WISH	:	Wadhvani Initiative for Sustainable Healthcar

1. Introduction

The first ever National Conference on Assistive Technology (AT) was conceived by Mobility India (MI) on the occasion of the 25th anniversary of its founding. The larger purpose was also clearly in focus. Globally, over 1 billion people are estimated to need assistive technology (AT) and assistive products such as wheelchairs, mobility aids, hearing aids, prosthetic and orthotic devices, low vision aids and communication aids to maintain or improve their functioning and independence. This is either because they are older people and/or are persons with disabilities (PWDs).

However, today only one in ten people in need have access to assistive technology. This leaves most PWDs and their families excluded, locked into poverty and isolation. It increases the vulnerability of PWDs to disease and further disability. WHO is coordinating the Global Cooperation on Assistive Technology (GATE) initiative to address this huge and unmet need. In India, the legal framework for protection of human rights of PWDs is rendered mostly inaccessible because of low budget allocation, administrative inefficiency, stigma and the intersectionality of discrimination. The AT conference, held on the occasion of MI's 25th anniversary, was aimed to bring together various stakeholders in public, private and voluntary sectors to help identify the best innovations/solutions available today to help scale-up and make AT available to all.

The expected outcomes of the conference included greater awareness of the need for AT, need for developing an AT eco-system, creating a network of AT stakeholders for multi-sectoral convergence within India and between India and the rest of the world.

2. Conference Objectives

The broad objective of the conference was to bring together all the relevant stakeholders to discuss, identify and agree on key steps to augment AT sector and develop a national AT alliance. The ultimate aim of the conference was to see how together we can change the quality of lives of people with various disabling conditions in a multi domain involved situations. The specific objectives were:

1. Create awareness on AT involving all key stakeholders, AT users in particular.
2. Connect AT with key development initiatives; especially Make in India and Skills India.
3. Connect Indian AT initiatives with the Global AT initiatives such as ATscale or WHO's GATE initiative.
4. Develop a taskforce to draft the National AT policy and Priority Assistive Products List.
5. Improving access to quality and affordable assistive technology to realize the goals of CRPD and SDG.

3. Unique features of the AT Conference

The National AT Conference held from 2nd – 3rd August 2019 was the first conference of its kind in the Asia-Pacific region as a whole. It was also the first such national conference in India held by an NGO. It drew in a range of stakeholders from the health, allied health services and rehabilitation sectors, INGOs, associations of rehabilitation professionals, user associations, disability activists, AT users, universities and colleges. Delegates to the conference came from 17 countries and 27 states to discuss the need for AT in the country. NIRTAR, one of the National institutes, had conducted an AT conference in 2018, but on a smaller scale. The AT Conference had 27 eminent speakers with expertise in AT from government and private sectors and from policy to grassroots levels.

4. Location and Venue

The conference was held at Bengaluru in South India. There is good connectivity by air, rail and road to the conference venue and access for PWDs. Bengaluru has a relatively pleasant climate the year round. All major international flights touch Bengaluru. The venue for the conference was the state-of-the-art Convention Centre of the National Institute for Mental Health & Neuro Sciences (NIMHANS) which offers exceptional facilities such as an auditorium that seats up to 850 persons, has advanced conferencing facilities, a well-appointed dining hall, ample parking facility, disabled-friendly access and amenities, and storage.

Hotel accommodation suggested to delegates were within a 3-5 km radius of the conference venue, are accessible, and have the convenience of taxi, auto and bus transport at reasonable cost. MI's accessible van was available on request from PWD delegates for transfers to and from their hotel or guest house at organizer's cost. One accessible van was stationed at the conference venue to meet any emergency needs of PWD and other delegates.

5. Summary of promotion activities

Preparations for the conference commenced as early as November 2018. Social media posts about the conference began to be posted on MI's Facebook page from then onwards. Email announcements of the conference were sent out to 5,000 professional colleges and networks of health, allied health services and rehabilitation sector persons, associations of professionals, user associations, disability activists, AT users, universities and colleges, and all 7 national institutes of disability education. Besides, the MI team made presentations to no less than 100 institutions. MI and its network organizations like ISPO, ISWP, WCN and others in turn posted on websites such as <https://enabled.in>, <https://wheelchairnetwork.org>, www.niepmd.tn.nic.in.

Requests for advertisements in the MI Souvenir brought out on the occasion were made among the network of MI's contacts including suppliers, national institutes, bankers, service providers, well-wishers and other NGOs.

The subject of disability, AT innovations and the conference event received media coverage through 10 online media releases on 3rd August 2019. It was also reported in 18 print media publications in Kannada, Telugu and Tamil and 1 Urdu daily, besides 2 English national dailies.

6. Audience Metrics and Participation

A total of 536 delegates attended the 2 days of the conference. Delegates to the conference came from 17 different countries and 27 states of India. Represented at the conference were clinical and allied healthcare professionals, engineers, innovators, NGOs, INGOs, disability activists, AT users, caregivers and family members, AT manufacturers and dealers, universities, researchers, design engineers, innovators, CSOs, DPOs, students of physiotherapy and disability studies, the national institutes, IITs and IISc, academic and certifying bodies. Thus, a panorama of stakeholders was present at the conference. Delegates to the conference were between the ages of 20-70. Of the delegates, 5% were PWDs. Some 30% of the total delegates were women including 11 women with disabilities. MI had invited students from physiotherapy, engineering and nursing colleges and regular schools in the city. As a result, visitors to the exhibition included groups of students from 4 physiotherapy colleges and also from city schools, recording footfalls of over 2,000 adults and children in all over the two days.

7. Collaborations and Sponsorship

Collaborators in the AT conference were the International Committee of the Red Cross (ICRC), New Delhi and the National Institute for Empowerment of Persons with Multiple Disabilities (NIEPMD) a national institute under the Ministry of Social Justice & Empowerment, Govt. of India. The conference was accredited by the Rehabilitation Council of India (RCI), which is the certifying body for professional course in India on rehabilitation studies. ICRC New Delhi, NIEPMD and REHAMO, an organization in the home healthcare products and services domain sponsored part of the conference costs.

8. Staffing and Preparations

A total of 6 committees with 38 persons were constituted to handle the preparations: an advisory committee, registration committee, technical program committee, communications & publication committee, exhibition & promotion committee, registration & reception committee. Sign language interpreters Ms. Sridevi Reddy, Mr. Sunil Kumar R. and Mr. Mulpur Adam were there throughout the conference proceedings. Video projection of the proceedings included sign language interpretation. Temporary ramps were put in place to make entry to the stage accessible for PWDs and wheelchair users. Amenities at the conference venue were accessible.

9. Programs and Speakers, Exhibitors, Poster presentations

The conference featured 16 invited speakers and 11 other presenters for the awards. The distinguished speakers came from WHO, the IITs, IISc, NID, the National Institutes, innovation hubs, INGOs, NGOs, public and private providers and DPOs. The 9 panelists for plenary sessions counted users/activists, academics, ministry officials, caregivers, innovators, healthcare professionals and UN agencies. Both the moderators were PWDs and disability rights activists. Experts in the field chaired and co-chaired the various sessions. There were awards instituted for the best innovation, paper presentation, exhibit and poster. There were 39 poster presentations for the competition. A total of 24 exhibitors displayed their products or services related to AT in the conference venue. (Refer Annex-2 for List of Chairs, Co-chairs and Moderators, Annex-3 for List of Speakers and Topics, Annex-5 for List of Poster Presentations, Annex-6 for List of Exhibitors)

10. Schedule of the Conference

The conference ran for the 2 days of August 2 and 3, 2019. It featured a total of 27 speakers and 2 plenary sessions. (Refer Annex- 1 for Programme Schedule of the Conference)

11. Conference Proceedings

The conference consisted of a series of presentations by 16 invited speakers. They spoke on topics under one of 7 themes:

- a) Need, demand and supply of AT
- b) AT service delivery systems, practices and outcomes
- c) Human resource development and AT
- d) Emerging and innovative assistive technologies with inter-disciplinary research
- e) User perspectives on AT
- f) AT in universal health coverage
- g) Universal Design and other general topics relating to AT

Besides, there were 11 presenters on a range of innovations in AT. The conference saw a total of 39 poster presentations made at the venue. Stalls for display of exhibits of AT products and services showed state-of-the-art in AT. There were 24 exhibits in all and also 2 four-wheel vehicles modified for accessibility on display. (Refer Annex-8 for Photo-glimpses from the Conference)

11.1 Day 1 of the Conference

The first day of the conference saw a total of 6 keynote sessions and 6 paper presentations and the inaugural ceremony, concluding with a panel discussion on user perspectives on AT. The inauguration commenced at 11.30 am. with an inspirational song “Heal the World” sung by students of Mobility India (MI). Dr. Charles Prabakar, President of MI welcomed the chief guest Dr. S. Sacchidananda, Vice-Chancellor (VC) of Rajiv Gandhi University of Health Sciences (RGUHS) and the guests of honor present. They included Smt. Lakshmi Nataraj, Corporator BBMP Ward 170, JP Nagar, Dr. Ashish Mukherjee, Director ISIC, New Delhi and Board member of MI, Mr. Basavaraju, State Commissioner for Disability, Karnataka, Dr. Himangshu Das, Director of NIEPMD, Dr. Patanjali Dev Nayar of WHO-SEARO, New Delhi, Mrs. Manimozhi Theodore, Director of DEBEL, Bengaluru, Dr. Surender Singh Oberoi, Commercial & Political Adviser to ICRC, New Delhi and Ms. Sowmya Reddy, MLA of Jayanagar constituency Bangalore.

Mr. Charles Prabakar, President of MI welcomed the guests. The honourable guests lit the traditional Indian lamp followed by the screening of a 20-minute documentary on MI’s work of the past 25 years with PWDs. The guests made brief addresses including conveying their best wishes for the event. Mr. Charles Prabakar spoke about how MI had grown from strength to strength over the 25 years, which it was celebrating that day. Dr. Ashish Mukherjee, organizing chairperson, reminded the gathering that ‘We may not be able to predict the future but suddenly we can invent the future’, and that MI would play a very important role in the movement.

Dr. Patanjali Dev Nayar very aptly reminded that the job of addressing concerns of PWDs was not just that of the government but everyone’s. Ms. Sowmya Reddy and Ms. Lakshmi Natarajan commended MI for providing services to PWDs from 25 years and wished it all strength to continue the good work. Ms. Manimozhi Theodore informed that many of the technologies available to the common man today has been developed by the country’s defence department. Mr. V. S. Basavaraju spoke about the need to build infrastructure, provide an eco-friendly environment to enable PWDs to have basic education, basic mobility aid and the right to live like anybody else.

Dr. Himangshu Das stressed the need for users, researchers and all those working on ATs to come together to share best practice and low-cost innovations. Dr. S.S. Oberoi shared some reminiscences of how AI and robotics can serve people in war-torn areas, and of ICRC’s projects to share technology, knowledge and experience to benefit PWDs. Chief Guest, Dr. Sacchidananda wanted that students be sensitized, take up more cross-disciplinary courses to meet future needs of those with disabilities. Ms. Albina Shankar, Director of MI thanked the honourable guests, and Mr. Chapal, the MI founder who could not be present, but was there with them all in spirit. Dr. Sacchidananda released a Souvenir on the occasion of MI’s 25th anniversary. Along with Ms. Sowmya Reddy, Dr. Sacchidananda inaugurated the conference as also the stall exhibition at the conference venue.

11.1.1 Speaker presentations Day 1

Dr. Patanjali Dev Nayar of WHO-SEARO delivered the keynote address. He spoke of how AT can impact peoples’ lives, delivering benefits beyond health to socio-economic benefits, and

changing the external environment in favour of the disabled person. Dr. Nayar stressed that improving access to AT involves equality, equity and innovation – AT solutions within the Indian context, trained personnel and funds to meet the needs. Quality and poverty are not necessarily at two ends. He also emphasized that besides demanding quality products and services, we also need to contribute as citizens in many ways – research, help people, be conscious of being part of India.

Dr. Gaurav Gupta, National Professional Officer (Injury & Disability Prevention) of WHO-INDIA, spoke of how PWDs have same healthcare needs as others, but are often denied healthcare. Lifestyle diseases and traffic accidents compound the problem. He stressed the need to introduce Universal Health Coverage (UHC), and appreciated the significant role played by NGOs in providing such common platforms towards sharing and suggesting views. The government's thrust is on increasing accessibility affordability and availability in the developing national disability action plan which also includes establishing a National Centre for Innovation in AT.

Dr. Himangshu Das, Director of NIEPMD, Chennai, pointed out to the gathering how perspectives have changed from charity to a rights-based approach in disability work, as the Rights of Persons with Disabilities Act 2016 shows. The government is also now beginning to work towards convergence of health, education and social justice ministries, and collaboration with NGOs and private industry.

The first afternoon speaker, Dr. Catherine Holloway, is co-founder and current Academic Director of Global Disability Innovation Hub (GDIH), and also Associate Professor at University College, UK. She reminded the gathering that although we can't possibly do everything, working in partnership with others in innovation can address the problems of PWDs. Thus, GDIH was able to sponsor the 2012 Paralympic Games, Enable Makeathon and other initiatives, eliciting the cooperation of other sectors. GDIH works to support innovation, data & evidence, the accessible built environment, and towards overcoming stigma through Paralympic sport and promoting innovation hubs.

Mr. Dilip Patro, himself a quadriplegic and founder of NGO, The Ability People, shared his own life experience of becoming disabled, and of his efforts to develop low-cost bladder and bowel management tools that can help improve the quality of health of survivors of spinal cord injury, in particular women.

Ms. Sampurna Guha, the next speaker, shared the results of her research survey on utilization of AT devices by special educators and caregivers of children with intellectual disabilities (ID). She said that awareness was key to increase utilization of ATs such as mobility aids, seating and positioning aids, daily living aids, assistive listening and augmented communication to benefit children with ID.

Ms. Saija Lukkarinen of ICRC spoke on humanitarian emergency response and AT from the ICRC perspective. From their experience of attending to needs of affected peoples in conflict and disaster situations across the world, ICRC sees that the challenge is to design assistive devices for humanitarian response which are of optimized function but also highly affordable, and also to increase awareness among people about assistive devices.

A presentation by Mr. Kishore Rao from service provider-cum-user perspective made the audience think deeper on AT in geriatrics and palliative care. A senior citizen himself, Mr. Rao prognosticated about the increase in older population in India and their need for multiple ATs. He stressed the critical need for social interaction – especially in old age – along with AT to add to the life of elders in society. Mr. Amitabh Kishore Dwivedi, a seasoned occupational therapist and academic discussed the barriers to the use of ATs by PWDs in India and made recommendations

on the eco-system, infrastructure and access, funding and ATs to address these barriers. Mr. Arvind Suresh Ambalapuzha, a tech innovator in AT, highlighted the development work being done by his start-up to improve the design of axillary crutches to mitigate or solve associated problems.

A young researcher Ms. Priya Mishra shared her findings of a survey done in Lucknow on the use of AT in higher education, which showed that the visually impaired are the largest cohort of users of AT for both academic and personal purposes. A researcher from the Netherlands volunteering at the Bangalore Baptist Hospital in Bengaluru talked about a survey that Baptist hospital has conducted among rural manual wheelchair (WC) users on services and devices. The survey feedback showed that satisfaction (and usability) of WCs is strongly dependent on support services, including WC skills training.

The afternoon of Day 1 concluded with a panel discussion on user perspectives on AT. Panelists included Ms. Rupmani Chhetri of Inkludo Consulting & Advisory, Bengaluru herself a hearing-impaired professional from Nepal was of the opinion that awareness and technology needs to be supplemented with interpreter services and high-speed Internet services to enable access to AT for hearing impaired persons like herself.

Dr. Deepti Shanbhag, a doctor and caregiver for a teenage son on the autism spectrum shared her challenges caring for a grown disabled son. She experiences lack of child-friendly assistive devices (AD) which can help for e.g. in WC transfers. She admitted facing barriers at every point – attitudinal, emotional, and environmental, not to speak of AT communication devices for someone on the spectrum. Dr. M. K. Sridhar, a physically disabled academic and professional urged for support for indigenous knowledge and intelligence which have led to development of low-cost user friendly assistive devices over formal high-cost products that are currently being produced for PWDs. He favoured sharing of formal and informal knowledge and innovations through a portal, which can get people to come together, share best practice.

Ms. Kuhu Das, moderator concluded the panel discussion by remarking that while much progress has been made in developing ADs, research to develop ATS and modernization of devices is a critical area, as is user-friendly and cost-effective devices within the reach of common people. (Refer Annex-4 for List of Panel Members in the Conference)

11.2 Day 2 of the Conference

Ms. Ritu Ghosh, Academics Director of MI welcomed the gathering at 9.30 am, and said that the day's presentations would be on various ATs and how to strategize to benefit people through AT. There were 10 keynote sessions and 5 paper presentations concluding with a panel discussion on the way forward and recommendations from the conference.

11.2.1 Speaker Presentations Day 2

Dr. Deepak Sharan shared information on the gaze-based technologies being developed by his organization RECOUP which was aimed to make life easier for those who cannot speak or have locomotor challenges such as those with cerebral palsy or SCI or are on the spectrum. These new technologies can enable them to use a head-mounted device and use their head movements to operate such devices so they can play games, watch videos, find locations on the map, search the Net and uses AI. Dr. Shirshendu Mukherjee of BIRAC and the BMGF focused on the support he has enabled to get AT innovations validated through establishing incubation centres, setting up a system of mentors and consultants and bringing devices to the stage of the market. These include the SmartCane and the DotBook. Mrs. Smita Jayavant of PDUIPH stressed the need to

establish universal design (UD) and a barrier-free environment and family/carer support for PWDs.

Dr. R.K. Srivastava, Senior Advisor-Innovation & Public Health of the Wadhvani Initiative for Sustainable Healthcare (WISH) spoke of India's public health system and universal health coverage (UHC). He was of the firm opinion that AT in health was achievable only through partnership of government with private actors and other agencies.

Dr. Dibakar Sen of IISc, Bengaluru gave an overview of some of IISc's explorations on one prosthetic device – the robotic hand, which creates natural motion by predicting movement, and is easy for the user to learn to use. Ms. Anusha Saipriya and her fellow research student Ms. Madhumita spoke on trials they are doing on an independent walker which allows upper position balance for children with diplegic cerebral palsy. If not given enough walking practice, children with DCP can suffer permanent deformity. Clinical trials are planned. Mr. Anil Kumar of Ottobock-India a manufacturer of quality prosthetic solutions, presented their work on a device used in upper motor neuron disease which affects arm and leg movements and causes foot drop. The device, fitted around the knee delivers functional-electrical stimulation to treat foot-drop.

Mr. Soikat Ghosh Moulic of MI and Mr. Girish Murthy, an entrepreneur manufacturing 3-D printers made a presentation on enabling AT in developing assistive devices through use of digital transformation in 3D printing. They have been working to develop prototypes of a prosthetic knee socket through scanning using a hand-held scanner, a computerized program and a 3D printer. It has high applicability to service needs in remote areas and conflict-affected areas with poor real-time access. Pilot trials are yet to be started. Dr. Kanagaraj of IIT Guwahati shared information on some of the ADs and biomedical devices such as inputs for cochlear implant, multi-axes ankle joint and orthotic knee brace, amputee walking simulator, a device for testing total hip arthroplasty and others. These are in the testing stage.

Mr. Ashok Mondal, faculty of Universal Design at the NID, Bengaluru enabled the gathering to view design from the user perspective. NID has developed a console to operate various domestic utilities in their homes to save mobility and response time for elderly or physically challenged. Dr. Ravi of BeTIC, IIT Mumbai highlighted the need for affordable quality AT devices in the country. The policy level, innovation, product and access challenges we are faced with must be addressed with adequate resources and expertise, consistent advocacy, increased exposure, capacity to assess and adoption of the latest technology.

The need to improve value-based care and service delivery to ensure quality of life for elderly people was stressed by Mr. Tarit Kumar Datta, the next speaker. This would be best done through ICT and designing geriatric training courses for health workers who assist in home-based care of older people, in particular older PWDs. The last speaker of the conference, Mr. Trivikram Annamalai of Atlassian, Bengaluru, made a presentation on a sitting-and-standing device for children with CP which he has designed with MI. As the child grows, the device grows with the child, in terms of adjustable back and foot rest, which reduces both cost and effort for frequent replacement in the early growing years of the child. He said his plans for an open access online tool of UCD canvas where you feed in analysis and key metrics to get customized online tool is on the anvil. (Insert hyperlink to the 15 speaker presentations of Day 2)

The proceedings of the 2 days were concluded with a panel discussion on the way forward moderated by Mr. Ankit Jindal of Friends for Inclusion. Panelists included Dr. Sara Varughese, Director of CBM-India, Dr. Gift Norman, Deputy Director of Baptist Hospital, Dr. Sujatha Srinivasan of IIT-Chennai, Ms. Smita Jayavant of PDUIPH, Dr. Gaurav Gupta of WHO and Dr. KVS Rao, Director - Dept. of Empowerment of PWDs, MSJ&E, Govt. of India. Ms. Smita was all for concentrating on low-cost affordable, scientifically developed and extensively tested field products to benefit the large majority, with hi-tech options kept to a minimum. Dr. Sara Varughese

was all for increasing community awareness, for scaling up affordable quality devices and strengthening human resources, especially with newer technology coming in. (Refer Annex-4 for List of Panel Members)

Dr. Sujatha Srinivasan, speaking from a technologist's point of view, pushed for convergence of efforts of academia and industry with NGOs, government organizations and users to benefit the maximum number of potential users. If start-ups could have access to some central testing facilities, or some regional hubs to get things prototyped it could help them in the costly research and development stage. She also mooted flexibility in funding – to focus on deliverables rather than on procedures.

Dr. Gift Norman of Baptist Hospital endorsed Dr. Sujatha's recommendations for dialogue and convergence along with the people 'out there', to move from stigma to pride and to keep talking (dialogue). He also urged for a more efficient delivery system. Ms. Sathyavathi, a service user from the audience pleaded for better accessibility in the entire transport system. Ms. Smita Jayavant brought to the awareness of the audience that entire enforcement of enabling laws for PWDs involved inter-sectoral cooperation and collaboration with other ministries. Mr. K.V.S. Rao and Mr. Ankit Jindal, the moderator both talked of the need for a National Accessibility and AT Policy which would lay down standards.

The valedictory function of the conference in the evening of 3rd August 2019 found Dr. Ashish Mukherjee appreciating the conference for the opportunity provided to stakeholders to interact on a common platform that could be taken up to wider levels. The chief guest for the valedictory was Mr. K.V. S. Rao, Director-DEPD under the MSJ&E. He distributed the awards to the winners in 4 categories – Best Paper Presentation, Best Poster Presentation, Best Innovator and the Best Stall Exhibitor. The selection process had been done by a panel of 10 judges with vast domain experience behind them. (Refer Annex-7 for List of Panel of Judges for the AT Conference Awards). The awards given were:

S. No.	Name of Award	Awardee	Award for
1.	Best Innovation	Mr. Karthik Venkat Sridaran, AISH, Mysore	A Low cost AAC device using "blow-slurp" technology
2.	Best Paper Presentation	Mr. Soikat Ghosh Moulic & Mr. Girish Murthy	Enabling fabrication of prosthetic and orthotic devices with additive manufacturing via digital transformation
3.	Best Exhibitor	Mr. Anil Kumar	Best Exhibit - Ottobock HealthCare - India
4.	Best Poster Presentation	Mr. Jenish J. (BPO student, MI)	Use of SMART materials in Assistive Technology

Mr. Rao concluded the conference with appreciation for MI for their work in the disability sector, and said that he was happy his department, NIEPMD and RCI were associated with MI. He regretted the lack of a National Assistive Technology Policy that can take care of innovation, collaboration, commercialization, and so on. And yet, it must be said that the new National Policy on Disability 2016 now covers 21 disabilities (as against 7 earlier), covers the continuum from pre-natal to health, education, employment, social security, deals with sports culture, skill development and many other aspects. In a departure from the previous law, it prescribes punishments for offences and violation of the law. There is an immediate need, said Mr. Rao, for survey by the states and the Centre to ensure inclusion of PWDs in education and employment.

He envisioned the 2 ministries of Health and Social Justice working together in future to address concerns of PWDs.

A one-page feedback form was handed out to among the delegates and collected back by the close of the conference. Mr. Soikat Ghosh Moulic of MI, Organizing Secretary for the conference, thanked the delegates and guests and all those within MI and outside who contributed to make it a successful event. The program ended with a moving video recital of the Indian national anthem by speech-disabled children at 6.30 pm.

12. Key Points Discussed

The key points discussed through the 2 days of the conference were multi-sectoral and multi-dimensional. The pertinent and prioritized ones have been grouped under the following heads: government/policy level, products & provision, linkages & convergence, innovation & invention and processes as below:

Government/Policy level

- 1) Dedicated fund for AT in the Health Ministry
- 2) Developing Priority Assistive Product List of India
- 3) Universal Health Coverage, including for disability, AT and therapy
- 4) MBBS (medical) curriculum to include awareness of disability rights and dignity of PWDs
- 5) Increased flexibility in funding for research with focus on deliverables
- 6) Enact a national Accessibility and AT policy

Products & Provision

- 1) System to standardize and regulate assistive products
- 2) Sharing of indigenous simple and affordable innovations/devices (both formal and based on local needs and wisdom) through special online groups/portals
- 3) Government to promote research & development, but also product distribution and repair services to reach common people
- 4) Accessible public toilets to be made available in public spaces
- 5) Improve access to AT and elder care through bottom-up planning and Universal Health Coverage

Linkages & Convergence

- 1) Directory of those working/researching/developing low-cost innovations
- 2) Common platform for various stakeholders to come together to address needs of PWDs
- 3) Inclusive design of the built environment to be mandated for all government/public/commercial buildings and spaces
- 4) Government to work together with NGOs and global funders/angel investors to bring innovative, low-cost AT solutions from ideation to prototyping, testing, manufacture, distribution and selling
- 5) Central testing facilities, or some regional hubs for start-ups to get prototyping done-reduce their costs and make the product development process more effective
- 6) Multi-sectoral collaboration to be enabled through a free access portal where all innovations - formal and informal - can be uploaded to trigger other innovations and bring people together to work towards common solutions

Innovation & Invention

- 1) Encourage indigenous knowledge and intelligence for making assistive devices locally
- 2) Portal or App for information to PWDs and caregivers on awareness of disabilities and AT
- 3) Develop hardware, software, a unified platform, data sharing and security, and products for 3D printing of prosthetic devices to reach remote communities
- 4) Develop a video calling app mobile

- 5) Government to enable 4G Internet connections across the country to enable inclusion of deaf people better than just hearing aids
- 6) Innovations to ease the physical burden of caregivers of PWDs e.g. ATs for WC transfers, etc

Processes

- 1) Appoint sign language interpreters in schools/colleges and public areas and service points
- 2) More organized training of personnel, skilled staff
- 3) Introduce awareness of disability in schools from pre-primary level onwards, and Greater awareness and sensitization for PWDs, families and other stakeholders
- 4) Cross-disciplinary courses like bio-technology, bio-medical engineering, medical electronics and genetics that can bridge the gap between engineering, prosthetics and medicine which are required to promote AT

13. Key Recommendations emerging from the Conference

The national conference on AT was held in the light of the lack of an enabling eco-system in India to provide the interlinked tools of Policy, Personnel, Products, Provision, People, Place and Pace as per the GATE framework of the WHO. MI, as an organisation working for 25 years in the disability sector is deeply concerned with the growing need for AT in India and the access gap for the needy. The conference aimed to bring together a network of stakeholders to identify the best innovations/solutions currently available to help scale and succeed AT.

In this, MI has been fairly successful. The conference saw a wide spectrum of stakeholders come together to dialogue on the importance of AT. Overall, it was agreed on the need for convergence of stakeholder efforts, and the importance of developing an enabling eco-system through innovation, development of new technologies and provision of low-cost and quality products to PWDs.

As a disabled activist present remarked, in start-up India, there is inadequate encouragement for entrepreneurs with disability. There is not a single disabled person on the boards of start-ups that are developing ATs. There is as of now, no special economic zone for ATs, and no tax incentives for entrepreneurs or health insurance coverage of ATs and follow-up therapy for users.

While AT products are there, it remains challenging to enable the eco-system to promote innovation, and to train and provide services. The standards for the built environment in the National Building Code need to be followed up with other standards to make products accessible and inclusive. Besides, it is time India began looking at developing an export market for world-class products. The recommendations that emerged from the conference came from various stakeholders who shared their experience as caregivers, users, innovators and start-ups, academics and researchers, policy makers and AT users. The key recommendations have been pulled together and placed before the delegates of the conference and a wider audience for consideration.

Recommendations

- 1) Dedicated fund for AT in the Health Ministry.
- 2) Universal Health Coverage for PWDs and elders which includes AT and therapy.
- 3) Special online groups/portals to allow PWDs the choice of service providers of simple and affordable innovations/devices.
- 4) Strengthen research and development, service delivery and follow-up mechanisms with service users including awareness.

- 5) Inclusive design of the built environment to be mandated for all government / public / commercial buildings and spaces.
- 6) Developing Priority Assistive Product List of India
- 7) Convergence of government with NGOs, research institutions, business & industry and global funders to take innovative, low-cost AT solutions from ideation to prototyping, testing, manufacture, distribution and selling.
- 8) Government to enable 4G Internet connections across the country to enable inclusion of PWDs and their better access to information and AT.
- 9) Introduce cross-disciplinary courses in academia and professional training colleges, and programmes for multi-skilling of professionals and personnel.
- 10) Greater awareness and sensitization for PWDs, families and other stakeholders, including through inclusion and diversity education for government, public, private and social sectors.
- 11) Enact a National Accessibility & AT policy complementing the RPWD Act 2016.

14. Reflection on organizing the Conference

The first national conference on Assistive Technology went off remarkably well, given the scale of the event. Some 536 delegates attended the conference, coming from over 27 states and 17 countries and from a wide spectrum of stakeholders. The delegates and speakers brought in perspectives on AT from policy to user levels. Users were involved in the conference from planning and organizing to presenting and moderating sessions. Local transport arrangements for PWD delegates could also have been better organized, given the fact that the conference venue was on one of the busiest roads in south Bangalore, and getting transport during peak hours can become challenging, especially for PWDs. One participant with spinal cord injury (SCI) faced a problem about inadequate access to accessible toilet facilities. The issue was taken up immediately by Mr. K.V. Rao of the MSJ&E attending the conference; and attended to immediately. Re-checking on accessibility of amenities - even in an accessible venue - before such a large event, is another learning for future events.

Feedback on the conference from delegates and invitees was largely positive and included remarks such as the following:

- ✓ New experience with AT. Came to know more about different mobility devices for the disabled.
- ✓ It was a wonderful, powerful, conversation that came to empower the disabled with AT.
- ✓ Grasped the magnitude in terms of numbers needing assistive devices. Saw most devices need adjustment to individual users. Saw most new developments are at early stages.
- ✓ We came to know that significance of assistive devices, adaptation of technologies about and accessible technologies.

Among **suggestions** made for MI to consider while organising future such events were:

- ✓ More participation of lawmakers at state & central levels. More stalls for senior citizens.
- ✓ Should be more CRE (continuing rehabilitation education) on AT related to deaf, blind etc, and on research methodology.
- ✓ Region wise convention to take the step to change policy for the welfare of the disabled.
- ✓ Kindly open short courses for allied health professionals to learn about multidisciplinary approach for all.
- ✓ Maintain timings for presentations. Give a little more time for questions. This (AT) is an area needing quick delivery to meet a great need.

15. Speaker Abstracts and Paper Reports

The text of presentations by the various speakers are to be had in the following pages. Annexes to the Conference Report follow these.

Speaker Presentations Day 1

Global Cooperation on Assistive Technology (GATE) and its relevance to India

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ABSTRACT

Assistive products enable and promote the inclusion, participation and engagement of persons with disabilities, ageing population and people with co-morbidities in the family, community and all areas of society, including the political, economic and social spheres. WHO estimates that there are more than 1 billion people who would benefit from one or more assistive products. With populations ageing and the prevalence of noncommunicable diseases rising across the world, this number is likely to rise above 2 billion by 2050, with many older people needing two or more products as they age. Those who most need assistive technology includes, among others: people with disability, older people, people with noncommunicable diseases, people with mental health conditions including dementia and autism, and people with gradual functional decline. However, today only 1 in 10 people in need have access to assistive products, owing to high costs and a lack of financing, availability, awareness and trained personnel. For example, 70 million people need a wheelchair but only 5–15% have access to one, and hearing aid production meets only 10% of global need and 3% of the need in low-income countries. Moreover, 200 million people with low vision do not have access to spectacles or other low-vision devices. This has a significant adverse impact on the education, livelihood, health and well-being of individual, and families, communities and societies of those who are deprived of the required and appropriate assistive products.

The inclusion of assistive technology, in line with countries national priority and context, into health systems is essential for realizing progress towards the targets in the Sustainable Development Goals relating to Universal Health Coverage. To ensure the remaining 90% of the population in need also have access to Assistive Technology, at a high-level meeting of the sixty-eighth session of the United Nations General Assembly on disability and development (New York, 23 September 2013), stakeholders requested WHO to develop and coordinate a global initiative to support Member States in realizing their obligations in the Convention on the Rights of Persons with Disabilities towards increasing access to assistive technology. Following a consultative meeting (Geneva, 3 and 4 July 2014), the Secretariat established the Global Cooperation on Assistive Technology in partnership with international organizations, donor agencies, professional organizations, academic institutions and user groups. GATE to inclusion, productivity, independence and freedom.

In 5 years, GATE has achieved many significant milestones and some of those are:

1. 24 May 2016: Launching of first WHO Priority Assistive Products List (APL)
2. 3 August 2017: 1st GREAT Summit – publication of the Global priority research agenda
3. 26 May 2018: 71 World Health Assembly Resolution on improving access to assistive technology
4. 24 June 2018: Formation of the Global Partnership for Assistive Technology: AT scale
5. A global community: 1301 experts/organization from 102 countries

There are many more important steps in in the pipeline, but most significant ones are:

1. Global Report on Assistive Technology - showcase the current global status - in terms of access to AT - with a comprehensive dataset, description, analysis and trends.
2. Collect global data in terms of need, demand, supply and impact of Priority Assistive Products
3. Second WHO Priority Assistive Products List (APL)
4. Introducing Training package on provision of Priority Assistive Products
5. Supporting countries to develop or strengthen national AT programme

Now coming to India – 1/6 global population with all possibilities and a possible highest need for AT in the world. WHO cannot reach to remaining 90% of the population in need without active engagement of India. At present, globally nearly 80% of the assistive products are produced in one country. WHO estimates current AT market is about 200 billion with potential to grow to a 1 trillion-dollar industry by 2030. AT sector has all the possibilities like pharma, medical or biotechnology sector – India made significant progress in these areas and now time to invest in the AT sector.

A comprehensive, sustainable and multisectoral approach to improving access to assistive technology to fulfill the safety and quality standards established by national and international regulations is need of the hour. WHO is looking forward to working with Indian stakeholders to develop the AT sector in India – serve the need of Indian and the global population. WHO and GATE are in consultation with Govt of India and bodies like ICMR to put easier access to AT on the national agenda by developing, implementing and strengthening policies and programmes amongst other initiatives.

What is opportunity, what is GATE, can we do something? Simple definition for Assistive Technology (AT): something as simple as a pair of spectacles which will help a child. AT is an umbrella term covering the systems and services related to the delivery of assistive products and services. Any product, as different from a medical product, which serves to improve an individual's functioning and independence, thereby promoting their health and well-being is called an Assistive Product. The impact of AT is far reaching. It overcomes challenges and facilitates day-to-day activities, going far beyond the benefits of health and well-being to individuals and their families. It yields socio-economic benefits by reducing direct health and welfare costs (e.g. hospital admissions or state benefits). It enables a more productive labour force, thus stimulating economic growth. It can also help overcome stigma to some extent.

AT can be simple or complex. Examples of low-tech tools for blind students might include enlarged text, raised line paper, while high-tech tools may encompass smart phones, 'digital' tools that "read" to the student, connect to a Braille display, or even incorporate GPS. AT changes the equation by changing the environment in favour of persons with disability, the aged, those with non-communicable diseases and others. E.g. for poor women with disability in Bangladesh where it enables them to participate in the workforce. There are more than 1 billion individuals today needing AT, but only 10% of them have access to AT. In this part of the world it is about 3-5% that have access. The numbers are projected to rise to 2 billion by 2050.

There is a gap between need, demand and supply. The need is so high. Demand is high, but supply is small. In economics 'market failure' term. High quality products are available to the rich, but only low-quality products for the poor (as charitable giving). There is high dependency on western/foreign markets. A hearing aid costing 200 dollars is being sold here for 5000 dollars by the time it passes through distributor, retailer, doctor, audiologist, technician to the ultimate user.

Of the thousands of AT products, there are only some 50 that we talk about. It is a paradigm shift when we see it not as disability but functioning, not as products for disabled but as essential health products, not charity social welfare but health sector response, not as expenditure but as investment. Improving access to AT involves equality, equity and innovation. WHO established Global Cooperation on Assistive Technology (GATE) on 4th July, 2014. An Assistive Products List came up in May 2016 – 50 essential AT products which the government should supply. The health ministers of Pakistan and Ecuador led the initiative. Big countries like India, Bangladesh were missing, but the small ones contributed. A WHO Summit on the GATE initiative was held on 3rd August 2017. The WHO Assembly resolution of 25th May 2018 was followed by a Global Disability Summit on 24th July 2018 which introduced ATscale, a global partnership for AT. It also introduced the AT provision framework: Policy, Personnel, Products, Provision with People at the heart of the framework.

A global report on AT is being prepared. The report will showcase the current global status in terms of access to AT. It will inform government and civil society about the need for and benefit of AT, especially the return on investment (RoI). It will also make concrete recommendations to improve access to AT, based on the best available scientific information.

We need Universal Health Coverage. I make a comparison between Norway and India. Norway has an AT budget of US\$325 million which serves 130,488 users (3.2 assistive devices per user). In Norway, 35% of products are recycled/refurbished, resulting in annual savings of US\$102 million! In India, for a population of 1.324 billion, there is no annual budget for AT, unknown number of users, long waiting period and high cost.

We need to design AT solutions within the Indian context. Use AI, exoskeleton, robotics assisted, glasses with stereo, GPS, etc. The prototype of AI glasses combines glasses with stereo sound sensors, and GPS technology attached to a tablet which can give spoken directions, recognize denominations of currency, read signs, identify colours, and other things. It also employs machine learning to recognize different places and objects. Because it uses ultrasound, it can also detect translucent obstacles like glass doors.

There are 120 examples of AI and AT. We don't have to duplicate these, we have to innovate by coming together. It's not India is not spending. But we don't have any consolidated fund of health ministry for AT, but only for appliances, consumables. We need to improve access to AT in India by policy, financing & data, bulk purchase from markets, train personnel and create 1-stop people-centred provision.

There is need for extended counselling on use of assistive products for users and caregivers. Not only for cochlear implant, but for many assistive products We need to support the adoption of an Assistive Products (AP) list, develop a national Apex AT Centre, collaborate with innovators and the social sector, and develop a research agenda with Indian Council for Medical Research and others. Deeper interaction with central and state governments and civil society is a must in the future. WHO's SEARO could lead an innovation partnership for technology and inclusion with calls for commitments. We need to develop funding instruments for research and development/scaling up of good practice, promote good design of products and services (universal design).

AT is a great enabler: it is the first step into education, the first step out of poverty, the first step into work and employment, the first step towards inclusion and participation, and the first step to enhance mobility, independence and freedom.

WHO Perspective on Assistive Technology

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ABSTRACT

There is a vast gap between the actual need and the availability of Assistive Technology in India. It is estimated that only 3-10 % of the needs are currently being satisfied. It's imperative that all key stakeholders take immediate steps to address this challenge at the earliest. Only then will it be possible to enable the persons with disabilities to be productive for themselves and help them integrate into the society.

My task has been made much easier by my mentor, motivator Dr. Nayar. On need, demand and supply of Assistive Technology (AT): the WHO perspective. We have focused on implementation at national level through engaging with Ministry of Health, Ministry of Social Justice. To take that forward, I recall how I lost my spectacles a few days back, and for 4 hours was not able to see much. I felt lost. Then got it back and it was like life was back! We can feel the importance of AT in our life just by removing the technology we are using. Many ATs are not coming up. IIT Delhi and IIT Guwahati are collaborating with WHO. The health indicators of WHO are mortality, morbidity, functioning. Rehabilitation is already there at national level programs, if we link AT, then we can sail into the national health policies. We don't need to reinvent the wheel.

PWDs have the same healthcare needs as others, but are often denied healthcare. So, their health condition continues to deteriorate, as a result of which they can't contribute to themselves or to society as a whole. 50% of PWDs cannot afford healthcare, and so get into catastrophic healthcare expenditure. This is further complicated by ageing, lifestyle diseases caused by not walking, by air-conditioning, etc. and so, more likely to develop non-communicable diseases than before. Almost everyone is using roads. But is each one of us vulnerable to road traffic injuries? Yes. Estimates have risen, especially for India, not just for deaths but also injuries. Infectious diseases also contribute to the need for AT. Unless we know what is the burden, we can't convince ministers at state and national level.

The day before yesterday, I was in Bangkok talking about this – the underestimation of injuries from road accidents. The source of information is the National Crime Records Bureau, the police. FIRs record only 50% of what is in police diaries. So those injuries that don't even reach the police are totally out of the net. As of now, we don't even know the burden. By 2030, more than 2 billion people will need AT. Disability is a developmental as well as a health issue. It is important that we work on it as a developmental issue too. The Convention on the Rights of Persons with Disabilities (CRPD) was passed in 2008. It outlines the civil, cultural, political, social and economic rights of PWDs. This historic human rights treaty provides a moral compass for action at national and international levels. The UN Standard Rules on the Equalization of Opportunities for PWDs were issued following 1982 World Program of Action Concerning Disabled Persons. The rules are: awareness raising, medical care, rehabilitation, support services as precondition for equal participation and personnel training.

The World Report on Disability was produced jointly by WHO and the World Bank. The WHO Global Disability Action Plan 2014-2021 was endorsed by member states in 2014, and calls to remove barriers and improve access to health services and programs, strengthen rehab, assistive devices and support services and community-based rehabilitation; and enhance collection of relevant and internationally comparable data, and research on disability and related services. It focuses on early identification and intervention, prevention of development of new impairments, and prevention of existing impairments becoming worse through improving access to healthcare and public-health programs.

We need to emphasize with the government to accelerate the approval of these programs. Sustainable Development Goals (SDGs) 4, 8, 10, 11 and 17 directly related to this important area. We need to work towards Universal Health Coverage to ensure that all people obtain the health services (promotive, preventive, curative, rehabilitative and palliative) that they need without suffering financial hardship when paying for them. NGOs play a significant role in providing such platforms towards sharing and suggesting views.

Systems challenge are awareness, accessibility and affordability. Strengthening the health system for integrated and equitable rehabilitation involves 5 dimensions: governance and leadership, financing, health information system, health workforce, essential medicines and AT. The Rights of Persons with Disabilities (RPWD) Act 2016 gives community PWDs the right to demand such services. But sorry to say, we have not been able to ensure such services for communities till date. The stakeholders are many including government officials, WHO and other UN agencies, rehabilitation service user groups and providers, funding and professional bodies, research institutions and other relevant international and NGOs.

The MBBS curriculum will be updated with inclusion of disability rights and the dignity of disabled people. Doctors will be familiarized with the RPWD Act, and also learn 'disability etiquette'. WHO is collaborating with Government of India on, among others, the concept note to establish a National Centre for Innovation in Assistive Technology.

First point for the way forward: keep talking, take one action point from this conference, and advocate for making it a political priority. Documents such as the National Policy on Disability and a national agenda on Disability Action Plan are still in the making. They will be open to all when approved.

Perspective from MSJ&E on Assistive Technology Provision in India

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ABSTRACT

The vision of the Department of Empowerment of Persons with Disabilities (Divyangjan) under the Ministry of Social Justice and Empowerment is to build an inclusive society in which equal opportunities are provided for growth and development of persons with disabilities to lead productive, safe and dignified lives. To achieve this vision, the Ministry undertakes research and development for technological advancement and appropriate technology for persons with disabilities; and also undertakes supply of aids and assistive devices to increase the accessibility for persons with disabilities through implementing agencies like National Institutes and schemes like ADIP (Assistance to Disabled Person for purchase/fitting of aids/appliances), SIPDA (Scheme of Implementation of Persons with Disabilities Act, 1995) etc. Additionally, public sector enterprise like ALIMCO (Artificial Limbs Manufacturing Corporation of India) manufacture and distributes various types of assistive devices for empowering and restoring the dignity of persons with disabilities. This article discusses the opportunities amongst the initiatives, recognizes the realities of the contexts in Indian scenario and provides an overview to the assistive technology resourcing priorities.

Keywords: Assistive Technology, Ministry of Social Justice and Empowerment, Government of India, Persons with Disabilities, Divyangjan

Introduction

Assistive Technologies includes any item, piece of equipment or product which is used to increase, maintain or improve the functional capabilities of people with disabilities (divyangjan). They play a significant role to enable functioning to live independent, productive, healthy, dignified lives; and to participate in education, the labour market and social life. Increased awareness and use of assistive technology presents substantial opportunities for many citizens to become, or continue being, meaningful participants in the society. Lack of assistive devices on the other hand, can result in people experiencing exclusion, poverty and increasing their support needs from their families and society.

International frameworks and instruments have highlight the commitments of governments and other stakeholders to support implementation and monitor progress that is relevant to assistive technologies. United Nations Convention on Rights of Persons with Disabilities (UNCRPD) mandates access to good quality and affordable assistive technologies for people with disabilities. Additionally, disability is referenced specifically in the Sustainable Development Goals (SDGs) related to poverty, education, growth and employment, inequality, accessibility of human settlements, and peace and inclusivity; disability is also directly referenced in the 12 SDG indicators. Achievement of all SDGs can be realized with improved access to assistive technologies.

People living in different regions of the country, under different economic conditions, and people with different impairments, genders, ages, languages and cultures do not have equal access to assistive aids and devices. The lack of access is due to high cost, limited availability, lack of awareness, lack of trained personnel, lack of governance and inadequate financing of assistive technologies. Additionally, inequalities in its access is usually found, as men are often more likely than women to have assistive technologies, adults are generally more likely to have them than

children, and people with specific type of impairment more frequently have assistive technologies than people with other impairments do. (Borg & Ostergen, 2015, p.302).

The Ministry of Social Justice and Empowerment and Department of Empowerment of Persons with Disabilities (divyangjan), Government of India; have many initiatives towards research and development of assistive devices and increasing their access across beneficiaries. The National Institutes that are the implementing agencies of Ministry, also undertake research directly and in collaboration with other agencies like DST (Department of Science and Technology) and other national/international universities/organizations; they also generate research grant through CSR (Corporate Social Responsibility) projects for innovative and novel technologies for persons with disabilities. They also model best practices for barrier-free accessible physical environment, ICT labs and accessible websites.

In many countries, access to assistive technology in the public sector is poor and non-existent. However, India has a very proactive ministry that offers the same through not just their schemes but also through its public-sector enterprise ALIMCO that manufactures and distributes various types of assistive devices for empowering and restoring the dignity of persons with disabilities. But still, the assistive products industry is currently limited and specialized, that needs user-centered research and development, procurement systems, quality and safety standards and context-appropriate product designs.

Since, there is a vast range of assistive technology devices that may include but are not limited to: mobility and dexterity, vision, hearing, communication and cognition. These assistive devices need to be accompanied with appropriate services including referral, assessment, prescription, funding, ordering, product preparation, fitting/adjusting of the product to the user, training of the user or family members, follow-up, and maintenance and repairs (Borg et al 2015, p.14).

However, considering the diverse demographic profile of beneficiaries and large geographic area of our country, at present the assistive technology services are in short supply and located far from each other; in addition to the dearth of trained personnel in manufacturing and adapting products or delivering services. An additional challenge is that limited research and innovation has been focused on developing robust, affordably but high quality assistive products; that depicts a technology divide with reference to high-income/high-tech contexts, as the majority of the beneficiaries are not benefiting from new technologies.

Also, at present, there is a lack of adequate regulation, with a need to adopt regulatory mechanisms to ensure that assistive aids/appliances in the market meet the relevant standards and are safe, effective and appropriate. Service provision is also in need of standards, to ensure that the users benefit from the technology and they don't get abandoned or cause harm to the user. Moreover, the available services are usually stand alone or fragmented; and we need to encourage transdisciplinary services that caters to the assistive device/technology needs of the individual and family. This will help catering to the individual factors such as health condition, body structure, body function, capacity, gender, age, ethnicity and preference; and efficiently help cater to the needs of growing children and adolescents for their assistive devices.

To address the lack of awareness among service providers and users about the range of available assistive devices and their benefits, the Ministry conducts several mega-camps for mass awareness and distribution of the assistive aids and appliances throughout the year. This effort shows Government's commitment towards adequate resources for addressing the unmet needs of low-income populace with disabilities. This initiative also helps reduce the stigma around disability and assistive devices, and further encourages disability rights and sharing of positive experiences of others.

The Ministry through National Trust has established a National Resource Centre for display of available assistive devices called 'Sambhav' at New Delhi, to demonstrate the possibility of independent or assistive living for persons with developmental disabilities through the use of aids and assistive devices and technologies. As a scheme, new 'Sambhav' centers will be established in other cities of the country that will provide useful information to improve quality of life of persons with disabilities.

To improve the access to assistive technologies, we need to develop a national framework for assistive technology and promote inter-sectoral actions for promoting affordable assistive products. Also, capacity-building of personnel through pre-service and in-service training and training of caregiver, along with enhanced integration of trans-disciplinary services will help provide solutions to improve access to assistive technologies.

Effective multi-sectoral collaborations for a holistic approach to foster functional capability and autonomy among beneficiaries of assistive devices, and encouraging universal designs for assistive technologies, buildings, transport, and information and communication technologies through actions across government and business sector; will help embed the national assistive technology framework within the system and also cultivate champions in different sectors to achieve goal of accessibility. Necessary action is also essential from the scientific community, research and development agencies and the manufacturing sector to fill the gaps through consultation with potential beneficiaries.

Various global frameworks such as UNCRPD and SDGs support government in improving access to these technologies, and the Ministry of Social Justice and Empowerment is committed through global collaboration, and national level multi-sectoral actions, to enhance the access to these technologies. From a life-span perspective, we must embrace the needs of people with disabilities across different age spans; that must cover the needs across education, employment and health. This can also be achieved through full and active participation of civil society and disabled people organizations, those who represent a diversity of users of assistive technology. We must remember that we are living in a rapidly changing world with digital revolution that is not only changing the way we live, learn, produce and even think; but also, changing decision making processes, the way information is delivered, problems are solved etc. Therefore, any assistive device/technology that is developed must keep in mind the human rights and social inclusion criteria for the beneficiary.

Fundamentally, we need to take a leap forward to user-centered thinking, crossing sectors in the same way as people's lives cross sectors. Without this change in approach, assistive technology may become increasingly divisive and inequitable; undermining the principles of social justice. Collaboratively, we must aim to provide and ensure sustainable, efficient and effective monitoring, supply and services of assistive technology to meet the changing needs across the life span. It is important to consider that while it is the people who empower people, assistive technology can contribute to creating conditions where this is possible!

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Global Disability Innovation Hub and AT Innovation in India

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ABSTRACT

Global Disability Innovation Hub (GDI Hub) is a new type of organization which tackles problems using a mission-focused approach; drawing in partners and disciplines as is necessary to address the challenges faced by people with disabilities globally [2]. To ensure solutions reach as wide an audience as possible the GDI Hub is two things – an Academic Research Centre (ARC) and a Community Interest Company (CIC). A CIC is a type of not-for-profit organization based in the UK. GDI Hub has its roots firmly in East London, where the London 2012 Paralympics were held, from here we have a global programme of action. GDI has worked closely with partners in India since we were established in 2016. We present two case studies of collaboration, which address the growing need for assistive technology (AT) to bridge accessibility gaps. The first explores the research question: Can the Internet of Things be used to automate the creation of wheelchair accessible maps in fast-changing cities such as Delhi? The study was undertaken by GDI Hub (UCL) and IIT Delhi with partners Leonard Cheshire and V-Shesh who recruited wheelchair users to map the area around Mangolpuri, Delhi. Maps were automatically created over a 2-week period and supplemented with users' pictures of the 'good' and 'bad' examples of accessibility. The results showed the method was valid, and the resulting application could map both physical and social elements of accessibility [1]. The second looks at the 2018 Enable Makeathon, held in Bangalore and East London, through a collaboration between the International Committee for the Red Cross (ICRC) and GDI Hub. We demonstrated that with: concentrated expertise on AT; access to AT users; encouragement to rapidly iterate designs and business development support, the concepts flourished alongside solid business models – many businesses have gone on to further success. These two case studies helped us to learn “what works” and we have used these learnings to explore opportunities for new collaborations, which harness the changing global landscape of disability innovation. Through the UK Department of International Development (DFID) funded £20m AT2030 programme, we are again ‘testing what works’ this time globally and with a focus on ensuring all people have access to assistive technology (AT). The problems identified in a recent scoping report set out the model [3]. GDI Hub are currently developing partnerships in India as part of this programme. We conclude with reflections on how to develop a global sustainable ecosystem of innovation.

My talk is to introduce you to Global Disability Innovation Hub (GDIH) and how we work with Indian partners. GDIH was launched to continue disability innovation that was begun with the 2012 Paralympic Games, which were the most accessible Olympic Games ever. As a part of the Paralympic Legacy, University College London is investing in a new campus on the Queen Elizabeth Olympic Park. GDI Hub is a part of this new UCL East campus. GDIH has three focal areas: policy & participation, innovation & entrepreneurship and research & training. We can't possibly do everything ourselves, but we believe that if we work in partnership with others in innovation, we can address the problems faced by persons with disabilities (PWDs). To do this we have launched a new MSc in Disability, Design and Innovation, which is a UCL degree offered in partnership with offered by the University of the Arts London (London College of Fashion) and Loughborough University.

The first case study research project we undertook was here in India. In Delhi. We partnered with Leonard Cheshire, V-Shesh, the Indian Institute of Technology, Delhi and University College, London. It was a project to put sensors on wheelchairs (WCs) to be able to collect push-style WC clinical data alongside geo-spatial data with 30 WC users. The project was a success, but we realized that getting the device to market would be challenging.

The second case study looked to address a systems level approach to AT innovation. Through the Enable Makeathon (in collaboration with International Committee of the Red Cross (ICRC) we helped to support innovation teams in Bangalore and London. I was blown by the innovation I saw in Bangalore. Through Enable Makeathon we began developing a new approach to disability innovation which has been instrumental in helping to establish the fundamentals of AT innovation support within AT2030.

Getting an AT from idea to market has always been difficult. To help accelerate change in this area, we conceptualized the AT2030 programme to provide the evidence for life changing assistive technology for all. AT2030 is needed because less than 10% of the estimated 1 billion people who need AT have access to it. What we needed was a systematic partnership. In July 2018, we published a Scoping Research Report on Assistive Technology in collaboration with DfiD, UK. In this report we state:

“The challenge of AT provision represents a complex web of market and system failure, compounded by a lack of participation from the communities that have the best knowledge of the issues (AT users themselves). This results in a supply/demand mismatch...making AT access one of the most pressing problems facing the global health sector, development agencies, governments, communities and families.” [3].

Today we count among our AT2030 partners: World Health Organization’s Global Cooperation on Assistive Technology Global (GATE), UCL, Clinton Health Access Initiative (CHAI), Leonard Cheshire, London School of Hygiene & Tropical Medicine, UNICEF, Eye Alliance, Motivation, Microsoft, University of Nairobi, University of Nairobi, ALL Institute, Hogan Lovells, ATscale, UNICEF, AMREF, GSMA and Fab City.

AT2030 is clustered into four areas: Data & Evidence, Innovation, Country Implementation, Capacity & Participation. Currently AT2030 operates in over 10 countries including: the Gambia, Liberia, Sierra Leone, South Africa, Kenya, Uganda, Bangladesh, Tajikistan, India, Indonesia and the Philippines.

The innovation cluster of activity is the focus for today. Within the AT2030 innovation cluster we are supporting Amparo – a graduate of Enable Makeathon. Amparo have created a socket which looks to overcome the challenges of lower limb prosthetic (LLP) fitting. Traditional fabrication of LLP sockets is a lengthy process that involves several hours of work from qualified technicians, multiple patient visits, and workshops equipped with expensive machinery. The Amparo confidence socket is a disruptive technology based on a new type of thermoplastic that allows prosthetic technicians to fit a patient with a new prosthetic socket in less than two hours. A portable vacuum pump and a heat gun are the only tools required to fit a prosthesis making the technology suitable for deployment in mobile clinics and low resourced settings.

The scoping work done made us realize that the Valley of Death (developing time) for AT is longer than for other start-ups. Interviews with innovators, investors and manufacturers showed that user-testing is often lacking. Therefore, we are supporting Amparo to test their innovation through pre-clinical trials in Kenya, Africa. We aim to understand the effectiveness and acceptability for both users and health providers in Kenya of Amparo’s new socket for LLP. The trial design was undertaken by Oxford Brookes University, and user-centred design by GDIH. AT2030 is supporting a clinical trial for the Amparo socket in two different sites in Kenya. 40 below the knee amputees are being fitted with new prosthetic legs that allow for new possibilities to become more independent. Prosthetic technicians are able to learn and master the new fitting technique in a few days and report high level of satisfaction for both themselves and their clients.

The Amparo trials are one of three trials we have conducted as we try to understand what different actors in the AT innovation space need to bring their innovations to market. We have also run trials with motivation and Humanity & inclusion. The lessons learned so far are:

- Start-ups and NGOs have benefit from assistance in developing detailed protocols for clinical trials and implementing these
- A partnership approach ensures a robust strategy to collect strong evidence for research purposes, which develops investment case
- Obtaining ethics approval requires time and support from both the research team at GDI and in-country organisations
- Setting up collaborations with sites for trials can be difficult for individual organizations and could be facilitated by the Innovate Now Ecosystem once in place
- Development of guidelines and walkthroughs explaining requirements for research and study designs could be extremely valuable for future start-ups supported by the Innovate Now Ecosystem

AT2030 has recently doubled in investment to £19.8m. Then increased investment has a keen focus on Africa, however, we will also be working with Indian partners to develop an innovation hub for the South East Asia region. Our increased funding also allows for the development of global case studies on Inclusive Design of the Built Environment, which we are repeatedly told is key to the success use of AT.

Through AT2030 we aim to reach 15 million people by harnessing public-private partnerships with PWDs at the heart of the decision-making process – 9 million directly and 6 million indirectly. We are grateful to UK aid for the funding and will work with partners to grow this funding base in the future.

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Role of AT in SCI-Healthy and Hygienic Bladder & Bowel Management

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ABSTRACT

For a person without a disability technology makes the task 'easier'. For a person with disability technology makes the task 'possible'.

70% of the road crash victims resulting SCI. More than 20,000 added annually for the existing 10 million in India. Technology plays an even more significant role in the life of someone with a severe disability as mentioned. AT is a process not just a product or device. I would like to mention very important AT intervention which is necessary rather comfort & luxury are Bladder & Bowel Management tools. Toileting is our primary focus. Being a quadriplegic and a dependent of assistive devices, I experience and understand the primary need of assistive Bowel and Bladder management tools to have a healthy life & privacy. Absence of timely intervention of these devices made most my fellow quads/para's infected resulting untimely death. My desire to provide affordable and available these devices in India as their cost is ten times higher in developed countries for the following: Catheter & Suppository Inserter, Digital Bowel Stimulator, Flexible Inspection Mirror, Knee Spreader with Mirror & Hand free cathing Inspection Mirror.

Network with existing technology and recommending commercial products by modifying and configuring the need by implementing the new design in AT. Presently our devices which are redesigned and able for mass production by maintaining hygienic and durability standards of Indian guidelines and policies including ethical clearance and Clinical study. These devices can be self-used or assisted. This leads to have dignified, independent and participant in society for personal & professional life. We have redesigned appropriate technology, components, choices, human resources to address the need of people in right manner and in right time. The focus is persons with disabilities who are economically challenged and do not have proper access to such technology. "Statistics on occurrence of spinal cord injuries in India clearly shows that victims of spinal cord injuries fall in the most productive age group of 20 – 40 years with 75% of them being male. Hence there is a strong requirement of AT devices and training in order to help patients become economically well-rehabilitated".

I hope when you see me in my wheelchair, it's totally a different aspect of my life. Earlier, before my accident, I was totally independent, never thought about the life of the disabled. But this happened to me and I found every step, every minute is a challenge to me. Are you all aware of what is spinal injury? Most of us, right? The difference between a person with spinal injury and one with disability is bowel and bladder control and mobility. In fact, 95 out of 100 persons with SCI don't come out of home because of this problem. I want to focus on Spinal Cord Injury (SCI). MI has helped me since 15 years and it has changed my life.

"For a person without a disability, technology makes the task easier. For a person with disability, technology makes the task possible."

Statistics show that 80% of SCI persons are road crash victims. Some 4.61 lacs road accidents reported in India in 2018. Every year 20,000 added to the 1.5 million with SCI, mounting each year. The average age of the victims is 31 years. SCI is permanent disability, there no cure in the world. My fingers don't function. But we (SCI persons) want to survive, lead a healthy life.

What are the barriers for life? About 70-80% of SCIs are living below the poverty line. They have to depend upon someone. I am today independent but need someone to assist me. No adequate policies or funding for SCI, no proper services, no proper devices, proper human resources, no systematic approach, we are not involved in any aspect of development of devices. My friends who have suffered UTI have untimely death, they were on dialysis. My primary focus is to have a healthy and independent life.

The physical challenges that people with SCI face: Cervical level 5-7 spinal-cord injuries are the most common, and often preserve partial function of the hand and arm that enable one's independence for managing daily chores. The bladder and bowel management skills are often left undeveloped by therapists and patients out of ignorance of their attainability with time and effort; and then due to unavailability of such tools locally. These barriers in accessing AT contribute to poorer health outcomes, less economic participation, higher rates of poverty, and increased dependency and restricted participation in society.

People with SCI face barriers in accessing AT. These include:

- 1) Inadequate policies and standards
- 2) Insufficient funding
- 3) NO services and NO production
- 4) Lack of human resources
- 5) Lack of awareness, cultural and social barriers
- 6) Lack of consultation and involvement

Our primary focus is on AT Bladder & Bowel Management tools for avoiding UTI and enabling the individual to lead a healthy and independent life. We have designed tools to fit the individual, accessible to all, indigenous, bio-compatible and suitable to the Indian climate. The tools are:

- Fit for the purpose – suiting the needs of the individual and their environment
- Technology that is simple and maintenance free
- Advanced technology, but not high cost technology
- Rapid fit – finish the whole business ASAP
- Makes use of locally available materials and components as much as possible
- Assistive technologies which are essential as they meet basic needs, enhance functioning at an affordable cost.
- Can enable people with disabilities to participate and be independent.

The biggest problem is majority cannot access it, so either at home or having a poor health. We have developed a local product, suitable to Indian climate. We also have some other issues which people don't know. People are uneducated and we are trying to teach them to use bladder and bowel management tools. The product has been redesigned for mass production and is one-tenth of the cost in developed countries. The most challenging part is training. We have developed videos in the vernacular language, Telugu. My friends who are using it, they found it very comfortable, though the suppository inserter is dependent upon assistance. If we can empty bladder and bowel in the morning, it is really comfortable for the whole day. Training can be given through videos and photos and delivered through mobile device.

For bowel and bladder management, there are Catheter & Suppository Inserter, Digital Bowel Stimulator, Flexible Inspection Mirror, Knee Spreader with Mirror & Hand free cathing Inspection Mirror. Paraplegics mostly don't use these but if they do, they will have a healthy and hygienic life. Every 3-6 months, the client may want to change the device (long to short handle or vice versa), but those using it are very happy with it. Particularly for women who don't come out of the home, it is very useful. With this bowel and bladder management device, people can go to office,

can be independent, have the right of privacy, and needn't be worried about any accidental leakage.

We have SCI groups in different states of India. The price is far less than what it is abroad. We have made a study of durability of the material. There has been no problem with the material and the tool we are using from the last 3 - 4 years. What is needed to provide affordable assistive devices on a large scale for SCI survivors:

- 1) Assess need and unmet needs
- 2) Provide adequate funding and improve affordability
- 3) Increase production and supply
- 4) Develop appropriate services
- 5) Educate and train relevant personnel
- 6) Establish partnerships
- 7) Maintain hygiene and durability standards of Indian guidelines and policies including ethical clearance and clinical study/trials

The service delivery mechanism to reach the above bowel and bladder management tools to people who need these: Initiative (the first contact with the service delivery system)

1. Assessment (evaluation of needs)
2. Selection of the assistive solution (defining the individual)
3. Selection of the equipment (choosing the specific equipment)
4. Authorization (obtaining funding)
5. Implementation (delivering the equipment to the user, fitting and training)
6. Management and Follow up (maintenance and periodic verification)

Being a quadriplegic and dependent on assistive devices, I experience and understand the primary need of assistive bowel and bladder management tools to have a healthy life & privacy. This enables me to have a dignified and independent life, and participate in personal & professional life in society.

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Assistive Technology (AT) and Intellectual Disability (ID): Exploring the Underutilization of Technology for Persons with Intellectual Disabilities

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ABSTRACT

Assistive Technology (AT) is an “umbrella term” comprising of various tools, techniques and services for promotion of functional independence of persons with various forms of disabilities and difficulties (Islim & Cagiltay, 2012). According to Census 2011, nearly 5.61 % Persons have Intellectual Disability (ID) in India (Data on disability, 2011). Such persons have significant limitations in intellectual functioning and adaptive behavior (AAIDD, 2010). Assistive Technology can assist PwID in areas of self-help, recreation, functional academics, occupation and mobility (Guha, 2016). The present study tries to shed light on the various factors responsible for low utilization of Assistive Technology by Persons with Intellectual Disability. A survey study was carried out with a sample size (n = 50) comprising of purposively selected special educators and parents of children with limitations in intellectual functioning. Mixed method research was used to analyze the obtained results in order to understand and explore the various factors involved in guiding the usage of assistive technology for those with intellectual impairment. The findings indicate that the following factors play a major role in low and underutilization of technological aids for the cognitively challenged: (1) lack of awareness - regarding age-appropriate, cost effective and need based AT tools among stakeholders (educators, service givers, parents and PwID) (2) lack of training - regarding usage of various AT devices and services, (3) lack of access - towards up-to-date, quality, affordable products and services (4) lack of affordability - some of the available tools and services are expensive and are often viewed as a luxury, (5) misconceptions and myths - about AT and (6) differing perspectives about AT - among special educators, parents and end users with ID. Hence the study makes an attempt to highlight the existing gaps between availability of assistive technology and its effective utilization. The present study can be used to understand the present scenario about AT and ID and thus find out ways to address these gaps enabling PwID to lead fuller, better and more independent lives.

Key words: Assistive Technology (AT), Independent living, Persons with Intellectual Disability (PwID), Underutilization

Introduction: Rapid advancements in the field of research and development have led to the emergence of ‘rehabilitation technology’ termed as ‘Assistive Technology’ (AT). Any instrument or device (tool) which assists individuals with difficulties or disabilities to perform activities which they are otherwise unable to perform is termed as Assistive Technology. It is a broad term which includes devices (hardware, software, standalone devices) and services. Depending on the nature and type of technology used these devices can be low tech, mid tech or high tech. These can be directly bought off the shelf or developed and customized as per user’s needs while the services focus on selection, acquisition, usage and maintenance of assistive devices. AT has the capacity to address user demands in various categories such as (Woods, 2019): (1) mobility aids, (2) seating and positioning aids, (3) daily living aids, (4) assistive listening aids, (5) augmentative communication aids, (6) visual aids, (7) academic and learning aids, (8) information access (9) vocational aids and (10) recreational aids. According to guidelines in IDEA the need for using and the nature of the assistive device to be used by children with special needs is determined by the IEP team. However, experience and findings from reviewed literature reveals that there is underutilization of such technology. According to Oliviera (2018) assistive technology has not reached its maximum potential and usage and there is much to be desired.

Research Methodology: Survey method was used to collect data from a sample comprising of special educators (n =15) and parents of children with intellectual disability (n = 35), purposively selected from areas in and around Coimbatore, Tamil Nadu. A valid and reliable rating scale, developed by the researcher, exclusively for the present study, was used named as Assistive Technology Underutilization Rating Scale (ATURS).

Findings: Results indicate that major factors which result in low and underutilization of assistive technology for Persons with Intellectual Disability (PwID) are: (1) lack of awareness-stakeholders are not aware about the usage of age-appropriate, cost effective and need based Assistive Technology for PwID (2) lack of training-it is seen that there is lack of adequate training regarding usage and maintenance of various assistive devices, (3) lack of access- despite increased global shift towards usage of such tools for rehabilitation of the disabled, yet there is lack of access and low acquisition of modern, quality, affordable products and services especially in developing countries; (4) lack of affordability–due to high costs of high technological assistive tools, they are inaccessible to a large percentage of the marginalized population thereby negatively impacting the effectiveness of AT; (5) misconceptions and myths – there are several misconceptions and widespread myths about such tools due to lack of sensitization and awareness (6) differing perspectives about AT- It is also observed that educators and parents have differing views on AT for ID. The teachers view AT as a supportive tool for training but parents feel it is the solution to all problems posed by cognitive challenges.

Research Impact: The findings indicate that greater awareness and sensitization needs to be created for PwID, their families, educators and trainers towards effective and efficient selection, acquisition and usage of customized, age appropriate assistive tools. Such devices should aim at provision of need based assistance to the disabled leading to their independence, empowerment, social, physical, and emotional integration. This will enhance their Quality of Life (QoL). The study further supports the need for creation of awareness regarding AT among the stakeholders for promotion of better inclusion and mainstreaming of PwID.

Limitations of study: Due to nature of sample such as small size and purposive selection the results obtained cannot be generalized to a larger population.

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Humanitarian Emergency Response and Assistive Technology – ICRC Insight

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ABSTRACT

The International Committee of the Red Cross (ICRC) is an independent and non-political organisation with a large scope of strictly humanitarian activities which it undertakes through its presence in over 80 countries around the world. It has a universally recognized responsibility to promote international humanitarian law (IHL) and to respond to the needs of people affected by situations of humanitarian concern, in particular armed conflict and violence.

The ICRC is part of the Red Cross / Red Crescent Movement, along with the National Red Cross / Red Crescent Societies and the International Federation of the Red Cross, who all have their distinguished roles in humanitarian emergencies. The ICRC utilizes assistive technology and devices in the framework of its health activities. Health related programmes aim to assure continuum of care from first aid, through primary health care to hospital care, health care in detention and physical rehabilitation, and eventually to socio-economic integration.

The ICRC, and more widely, the Red Cross Movement response in humanitarian situations can be acute, rapid response or longer-term support for example in situations of prolonged crises or during rebuilding and restoration work after crises. In an acute humanitarian situation affected people might need assistive devices such as fracture braces, walking aids, wheelchairs provided in field hospitals, or devices related to physiotherapy interventions in a surgical team. In more stabilized situations, the ICRC utilises its expertise in the field of physical rehabilitation through supporting projects in more than 30 countries and has developed its own in-house technology. The ICRC is also actively following the development and new innovations of the sector.

The main objective of the ICRC's physical rehabilitation programme is to help persons with disabilities restore their mobility in order to facilitate social integration, participation in education, and to increase livelihood opportunities and eventually to live a life of dignity with greater independency.

The International Committee of the Red Cross, ICRC, has been in the humanitarian field for over 150 years to respond to the needs of people affected by situations of humanitarian concern. ICRC is part of the Red Cross and Red Crescent Movement, along with the National Societies and the International Federation of the Red Cross. The Red Cross Movement is present in almost all countries around the world through National Societies, which provide humanitarian services including disaster relief. The Federation coordinates international assistance to victims of natural and technological disasters, to refugees and in health emergencies.

ICRC uses assistive technology in the framework of its health activities in over 80 countries. ICRC's Health related programs aim to assure continuity between different health services and through the entire duration of healthcare: from first aid and primary healthcare to hospital care, to healthcare services in detention and services related to physical rehabilitation. In acute first aid and hospital level response, affected people might need assistive devices like fracture braces, walking aids and wheelchairs, or devices related to physiotherapy interventions.

Especially in prolonged crises and during the rebuilding phases, ICRC physical rehabilitation program plays an active role. Often, in areas where we work, the health sector is not fully developed or functional before a crisis strikes, which puts pressure on already scarce resources. In some contexts, like Afghanistan, humanitarian response has stretched on for decades. With

over 40 years of experience in physical rehabilitation, ICRC works with the sector through support to physical rehabilitation centers. These centers provide all kind of devices that aim to increase the functionality of a person, with emphasizes on multidisciplinary approach.

This long expertise is also crucial when planning disability inclusive humanitarian response. In some countries, ICRC along with its movement partners works with authorities and other disaster management actors to plan better preparedness. We have also been involved in the process of drafting the minimum technical standards and recommendations for rehabilitation in emergency medical teams, in collaboration with the World Health Organization.

When crisis occurs, be it natural or man-made, persons with disabilities are especially affected. Disasters can result in an increase of number of persons with disabilities owing to new injuries, lack of quality medical care or collapse of essential services. Ensuring inclusion of persons with disabilities during emergency response should be considered a core component of humanitarian action. Collaboration and interaction between different actors is another key factor in improved disaster response, as well as the inclusion of communities in the preparedness and response planning stages. Sometimes, ICRC responds to the situations of acute humanitarian concerns through its established partners. Last year, we successfully supported Mobility India during the Kerala floods in providing assistance and delivering required devices.

Today's humanitarian emergencies and challenges are highly complex and can have various root problems in different combinations: natural disasters can happen in areas already affected by violence; transmissible diseases can spread in areas already impacted by poverty. On the other hand, the means and technologies used to predict, plan and respond to humanitarian emergencies are also evolving. This is true for assistive devices and technologies too. Today, the spectrum within the assistive technology field is vast, and conditions and disabilities require unique solutions. This has even led to professional separations.

One important step towards understanding the assistive technology as umbrella and all-embracing concept is the WHO list of priority assistive products. This list is an important step to unite and guide the discussion, as it raises awareness and reflects the needs related to different situations in life leading to need of assistive devices, not only to ones related to disability. Also, the list combines ready- and custom-made devices and covers different kinds of disabilities.

For ICRC, the most important consideration is that person in need of assistance gets the required help as per recognized professional standards. Provision of healthcare, including assistive devices, requires expertise and trained personnel and even in situations of sudden humanitarian crises, quality should not be compromised. For example, there might be an option of distributing wheelchairs on a large scale without individual assessment and fitting, but this can potentially cause harm to the users. The authority and integrity of any institution providing healthcare in humanitarian situations depends on its capacity to provide or support services that follow professional standards. Skilled staff remains the key to quality services and therefore, there is a constant need to invest in the development of human resources.

All the above leads one to notice that today, assistive technology is for everyone: it is increasingly important to consider the needs of the elderly, sick, and the ones in recovery. As this need for assistive devices remains unmet, the demand for good quality but affordable devices continue to grow. What is required is "appropriate technology" and designs with consideration given to the environmental, cultural, social and economic factors that influence communities and individuals.

In the past, to answer this very need in field of prosthetics and orthotics, ICRC developed its own prosthetic technology, which has been successfully utilized in many places around the world. In current world, there is a lot of potential in the new technologies to answer this same request. There is also a need to improve processes and systems; starting from the purchase and

manufacturing to increasing utilization of readymade items and components, when possible, but also parallelly increase the possibility for individual fitting when required. Humanitarian Innovation, 3D printing, new materials are all potential solutions for the future.

Our ambition is also to maintain a reputation as a professional point of reference. This also requires adaptation to new technologies and evolving needs, as well as to different requirements of different contexts.

In this regard, ICRC in India initiated few years ago an innovation competition, Enable Makeathon, to search for new solutions in assistive technology for challenges faced by persons with disabilities. India, and especially Bangalore was the natural choice as location for this competition as it has gained a reputation as hub for innovation and new ideas.

Finally, besides the availability of devices and services, it is also still important to increase awareness about assistive devices among professionals and other actors, as well as those in need of these services. A well fitted device is often a life changer, during emergency as well as in every-daily rehabilitation work.

Assistive Technology in Geriatrics and Palliative Care

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ABSTRACT

Whereas everyone might not get disabled in life there are more possibilities of becoming an octogenarian. Aging is a natural process and aging with some impediments or weaknesses is quite normal. Both these bring up the need for bettering one’s quality of life with the use of technology as one ages. As we age we might find it harder to see clearly or to hear well or to climb stairs or to even remember one’s own name. How frustrating it could be to find it difficult to pick up your food from your plate and traverse that long distance up to your mouth without spilling all or a part of it? How difficult it could be for one to recognize the correct light switch but not being able to reach it because your hand does not obey your mind. Not being able to recognize your dear ones and not being able to articulate that you are in pain is the ultimate sad occurrence. WHO talks about Assistive Technology being an umbrella term covering the systems and services related to the delivery of assistive products and services as one ages. Assistive products maintain or improve an individual’s functioning and independence, thereby promoting their well-being. Hearing aids, wheelchairs, communication aids, spectacles, prostheses, pill organizers and memory aids are all examples of assistive products. Globally, more than 1 billion people need 1 or more assistive products. With an ageing global population and a rise in noncommunicable diseases, more than 2 billion people will need at least 1 assistive product by 2030, with many older people needing 2 or more. Having lived a long, active life makes it more difficult to reconcile to the fact that one desires to continue to be active but are not able to because of a physical infirmity or a cognitive problem. The frustration this brings about also needs to be addressed and counsellors are trained to bring about acceptance of one’s circumstances. So, a proper approach to addressing a psychological need is as important as providing a well-made and imaginatively designed gadget as one gets older. Altogether, maintaining one’s dignity is as essential as providing physical mobility as one approaches one’s golden years.

In today’s world there are more chances of one becoming an octogenarian than becoming physically disabled. Aging is a natural process and aging with some impediments or weaknesses is quite normal. Both these bring up the need for bettering one’s quality of life with the use of technology as one ages. As we age, we might find it harder to see clearly or to hear well or to climb stairs or to even remember one’s own name. How frustrating it could be to find it difficult to pick up your food from your plate and traverse that long distance up to your mouth without spilling all or a part of it? How difficult it could be for one to recognize the correct light switch but not being able to reach it because your hand does not obey your brain. Not being able to recognize your dear ones and not being able to articulate that you are in pain is the ultimate sad occurrence. After a useful, productive, independent life the biggest frustration would be if one is unable to move, speak, hear etc. without assistance.

Often, we are surprised by the normal changes that affect our bodies as we age. They simply creep up on us. It is important, however, to recognize that these changes can cause barriers to an active, independent life for persons who are getting older. Even though we do not want to think of ourselves as having a disability, a significant number of older people experience functional limitations associated with disabilities. These age-related changes often require us to make some changes in our daily lives. Although we cannot reverse the aging process, we can find effective ways to cope with it! More and more older citizens are discovering that assistive technology devices and services and home modifications provide new ways to "get around" these limitations.

WHO talks about Assistive Technology being an umbrella term covering the systems and services related to the delivery of assistive products and services as one ages. Assistive products maintain or improve an individual's functioning and independence, thereby promoting their well-being. Hearing aids, wheelchairs, communication aids, spectacles, prostheses, pill organizers and memory aids are all examples of assistive products. Globally, more than one billion people need one or more assistive products during their life-times. With an ageing global population and a rise in noncommunicable diseases, more than two billion people will need at least one assistive product by 2030, with many older people needing two or more.

Assistive technology, with its wide array of devices, is redefining the possibility of fostering the dignity, independence, and security of older persons. These devices can help elders to perform tasks around the home, to enjoy recreation and leisure activities, to communicate with family and friends, to regulate medications, to summon help in an emergency and ensure their own safety and security. Research suggests that using assistive technology is playing an increasingly significant role in helping older people to remain living in their homes and communities longer, realize their potential to remain independent and productive thus reducing reliance on family caregivers and expensive long- term care services.

Let us, then, attempt an appropriate definition: "Assistive Technology is any device or piece of equipment, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with either temporary or permanent disabilities."

Any device that is designed, made, or adapted to assist a person perform a particular task is called an assistive device. Assistive technology can be simple or complex. It can be fastening a tape on clothes in place of buttons, or using magnifiers for enlarging print. Assistive technology can also be more complex devices, such as, modified hand controls for cars, talking computers and wheelchair lifts or modified homes. All, or many, of these are now available in India.

Assistive devices can also be used for seeing, writing, reading, listening, eating, cooking, dressing, bathing, toileting, driving, telephoning, communication, mobility, household chores, etc, etc – in short, performing all activities essential for independent living. Use of assistive devices also makes the elderly feel several years younger since they will be able to manage their life with more independence and least support.

With the primary objective being to enhance the quality of life and to support older persons to lead positive and meaningful lives as long as possible the use of assistive technology/assistive devices can be of immense help to older persons and their carers.

Having lived a long, active life makes it more difficult to reconcile to the fact that one desires to continue to be active but are not able to do so because of a physical infirmity or a cognitive problem. The frustration this brings about also needs to be addressed and counsellors are trained to bring about acceptance of one's circumstances. So, a proper approach to addressing a psychological need is as important as providing a well-made and imaginatively designed gadget as one gets older. The accepting of one's inability (not disability) and intelligent use of these aids also relieves the strain and sense of guilt among the younger relatives who now have to travel far and wide for their professional needs and it gives them, and the older generation, a comfortable and happy period of life in their sunset years.

Altogether, maintaining one's peace and dignity is as essential as providing physical mobility. As one approaches one's golden years, appropriate assistance needs to be provided.

Exploring Barriers to the Use of Assistive Technology for PWDs in India

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ABSTRACT

Assistive Technology (AT) can have significant beneficial effects for people with disabilities (PWDs) but there are also many barriers to their use. These barriers need to be analyzed in order to improve their overall quality of life. Accessible India Campaign under the Department of Empowerment of Persons with Disabilities (DEPwD), Ministry of Social Justice and Empowerment, aims at achieving universal accessibility for persons with disabilities and to create an enabling and barrier-free environment for them. While assistive technologies such as advanced wheelchairs may help PwDs become employed or return to work, many non-technological barriers cause that promise to go unfulfilled. In this reference the present study has been done to identify various barriers to the use of AT among the PwDs in India by conducting a survey in different parts of the country. India has over 70 million plus people in the disabled category and the use of AT is of great importance for them. This study aims to explore various barriers to implementing assistive technology for PwDs in India to help them to live an independent and productive life.

Introduction

Accessibility is a measure of the extent to which a product or service can be used by a person with a disability as effectively as it can be used by a person without that disability. Until a few decades ago, it was almost unimaginable for the disabled to lead independent lives. The advent of technology and internet has, however, opened new doors. At the same time persons with disability (PwDs) are experiencing a lack of access to technologies due to visual, hearing, mental, and/or other impairments that make it difficult to operate various devices. Other groups facing accessibility issues are illiterate and elderly populations. Making resources and information accessible to persons with disabilities is of great importance in this scenario as more and more people will start requiring accessibility. The purpose of this paper is to identify the potential barriers faced by the people with disabilities in using the AT by conducting survey and by reviewing the available literature.

Review of Literature

Many researchers have worked on the uses and benefits of AT for the people of all ages with multiple disabilities but a little literature is available on the barriers faced by PwDs in India in using it. Although developments in AT are present to enhance the quality of life of the people with multiple disabilities, many instructors feel intimidated and unsuccessful in this endeavour because of barriers they face in implementing technology they lack knowledge about.

AT provides numerous benefits for PwDs. It can be used to overcome the social, infrastructure and other barriers experienced by disabled people that prevent their full and equal participation in all aspects of society.¹⁴ Similarly, it has been pointed out that AT allows people to continue in their normal roles and meet their expectations of life despite their physical impairment and disability.¹⁵

In an examination of occupational therapy training programmes in the early 1990s, minimal course content related to AT was identified, suggesting that occupational therapy graduates may be ill-prepared to fulfil their roles in technology teams.^{16,17} Further research confirmed that school-

based occupational therapists found to use AT with only a small percentage of their caseload. A principal reason cited for low rates of use was insufficient expertise to allow investigation and application of different devices.¹⁹

Lack of personnel with proper training in appropriate mobility device services is also a major barrier. In many developing countries like India, production of mobility devices is done only on a small scale, or perhaps not at all, due to limited access to materials, machinery and expertise.²⁵

Methodology

A survey was conducted through a questionnaire containing 18 multiple choice questions related to the problems associated with the use of AT among a sample of about 100 PwDs belonging to all age from different cities of India. The questionnaire was distributed to occupational therapists working in different parts of India. With their help each participant was separately interviewed and the data were collected through electronic media. In case of children their parents/ guardians were interviewed. Both the persons who were already using assistive devices and those who were in need of assistive devices were included. Among those waiting for assistive technology, there were participants who had used it previously and been forced to discontinue because of some reasons.

In addition to the survey, the literature available on barriers to the use of AT in India was also reviewed as a part of study in order to identify current barriers to effective incorporation of AT among PwDs.

Result and Discussion

With rising life expectancy, there is a rapid increase in the number of elderly persons worldwide. Lack of awareness about new assistive devices was a major hindrance in using AT by elderly population in India.

India is a developing country and around 30% of total population lives below the poverty line. The major barriers for not making use of AT were found to include lack of funding and high cost of these devices. Most of them do not earn enough to buy these devices and depend totally on Government/ NGOs for funding. Even if they manage to get these devices the next major issue is the repairing and maintenance of the device which is again very costly and unaffordable for such people.

The prime barrier faced by people who are financially sound is the scarcity of skilled professionals. Lack of awareness about newer and quality devices amongst these professionals restricts them to recommend a compatible device. Some of the existing users got information from various other sources, such as friends and the media. Another major barrier to the effective use and implementation of AT is the lack of training facilities for the instructors. As a result, they are unable to give complete information about the use and maintenance of prescribed devices.

The socio-psychological attributes greatly hinder the adoption of AT. Sometimes the unintentional negative social behaviour promotes a sense of positive discrimination; pity and sympathy for PwDs which can make them feel self-conscious resulting in hindering the adoption of AT. Curiosity and unwanted attention from others can also lead to discrimination, thus hindering its usage.

The results show that multiple barriers exist for the use of assistive devices for PwDs in India which may have a major impact on their lives and livelihoods and may reduce their quality of life. Most of the people surveyed in this study believe that the use of proper AT can reduce stress and as a result can help to improve their quality of life so that they would be able to contribute greatly towards society.

Conclusion

The first-time users faced economic barriers, availability barriers, awareness barriers and psychological barriers, whereas persons already using AT faced repair and maintenance barriers, accessibility barriers and psychological barriers in addition to the barriers encountered by the first-time users.

Thus, there is a need for expansion of current technology adoption models to give them an increasingly balanced outlook. Therefore, in order to increase the use of AT, there is a great need for skilled occupational therapists who can understand the feelings and experiences of PwDs. Also, the local infrastructure and accessibility facilities, heightening public awareness, ensuring funding and a continuous supply of assistive devices supported by maintenance services should be improved. Persons with physical disabilities should be helped to gain more knowledge about assistive devices, especially about the availability of more modern ones. They should be given support to modify their physical and social environments.

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An in-depth user study on Problems Faced by Axillary Crutch Users in India

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ABSTRACT

Axillary Crutches is the largest mobility aid distributed in India by number. Distributed free of cost through Government ADIP scheme and Corporate Social Responsibility projects, they fulfill the bare basic functionality. The overall tendency of the ecosystem in India is to keep cost low by sacrificing rather than providing value to the people receiving the crutches. Even when the Axillary crutches is ISI 5143:1988 standardized, many complains have been received. We undertook a study of 100+ users with open-ended questions to learn how effective is the current design of Axillary crutch in empowering the user's life. It has been found that the design has issues related to both utility and usability. Most of the users face problems ranging from falling due to slippage to medical side effects like crutch palsy on long term usage. Most of the rubber tips available in the market wear off in very less time. Due to lack of proper physiotherapy in the country, the users are not trained to use them properly resulting in Scoliosis and Kyphosis. Callus formation due to lack of improper cushioning, abrasion of armpit with axillary pads some of the noted problem. Apart from that, it was found that fundamentally the crutch usage requires much energy consumption compared to walking. The study led to come up with possible potential design modifications which improve the quality of life of users. The suggestions include shock absorption, Tip with high durability, anti-slippage and self-standing, ease to carry on stairs and a fitment to carry on bike. The Full paper describes in detail the problems along with photos and the frugal methods they use to overcome it.

Axillary Crutches are the largest mobility aid distributed in India by number. Distributed free of cost through Government ADIP scheme and Corporate Social Responsibility projects, they fulfill the bare basic functionality. The overall tendency of the ecosystem in India is to keep cost low by sacrificing rather than providing value to the people receiving the crutches. Even when most of the freely distributed Axillary crutches are conforming to IS 5143 standards, many complains have been received. We undertook a study of 100+ users with open-ended questions to learn how effective is the current design of Axillary crutch in empowering the user's life. It has been found that the design has issues related to both utility and usability. Most of the crutch ferrule (rubber tips) available in the market wears off in very less time. Due to lack of proper crutch distribution system which ideally should start with training by physiotherapists, the users are not trained to use the crutches properly resulting in medical conditions such as Scoliosis, Kyphosis and Crutch palsy. Callus formation due to lack of improper cushioning, abrasion of armpit with axillary pads and falling due to slippage are some of the additionally noted problems. Apart from that, it was found that fundamentally the crutch usage requires much energy compared to walking. The study led to come up with possible potential design modifications which improve the quality of life of users. The suggestions include shock absorption, Tip with high durability, anti-slippage and self-standing ability, ease of carrying on stairs and fitment to carry on the bike.

Assessment Design

A study has been conducted considering various demographics like age, sex, type of disability, occupation, type of environment with various NGO's like AADI, Jaipur Foot, Freedom Foundation and hospitals like AIIMS-Delhi, Military Hospital Kirkee. Apart from the users, the stake holders like physiotherapist, rehabilitation experts, occupational therapists, orthopedic doctors were also interviewed to understand the prescription of crutches followed by training. The Activities of Daily

Life (ADL) of person using Axillary crutches are same as an abled person. Since crutches consume an extra volume as compared to a person using prosthesis, it has some usability issues. In practice, ADL covers bathing, dressing, using stairs, but nowadays users are also concerned about using mobile phone, picking up crutches, walking in the dark, travelling in public transport. The study is designed to understand the limitations of the users in performing daily life activities where human device interaction is necessary. Further, the effects of usage of the current BIS standard design is also compiled.

Insights

Daily life activities like walking on stairs, dressing, using toilets and even sitting are difficult to perform with crutches. These daily activities need to be done by the person without actually affecting their efficiency to perform using crutches. The users are forced to sit in the corners since the crutch need support to lean. This make people unable to sit in center of the rooms reducing their confidence. The other main problem is they are not able to locate them in the dark. Even if they find it, it becomes difficult to use it in less light conditions without use of a flash light. Normal crutch bottoms are very much suited for soft floor usage. Using them in normal roads and platforms are very difficult. Continuous usage of crutch erodes rubber present on the bottom of the crutch. Hence, a newer design which can be used at any terrain and rubber bottom which does not erode easily is also required. Energy spent by a crutch user is as twice as energy used by a person who walks normally. Energy expenditure is a major issue since crutch users spend more energy on walking using a crutch. Therefore, a crutch which reduces energy expenditure is required. The more amount of energy is spent mainly due to upper body's reaction to the shock of impact and to the vertical movement needed to clear the feet in the swing phase.

Suggestions

- Change of a new material instead of traditional rubber tip which does not erode easily and lasts longer than normal rubber tips.
- Inclusion of torch light in crutches enabling users to navigate their ways easily in light.
- Usage of reflective stickers for easy identification in dark.
- Design crutches which enable users to sit anywhere. i.e.: Not only in corners and even in center of the rooms.
- Proper padding under axilla and good handgrips are required to reduce abrasion of skin underarms and reduce impact on palms.
- Crutches which can be used in any terrain.
- Crutches which reduce energy expenditure of the subject.
- Crutches which transfers less impulse forces to upper body and thus preventing Scoliosis, Kyphosis, crutch palsy, callus formation and carpal tunnel syndrome.

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“Perception towards use of Assistive Technology in Higher Education: A case study”

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ABSTRACT

This study focuses on perception towards use of Assistive Technologies (ATs) by students with disabilities. This study conducted with the objective to find out the use of ATs in the academic, mobility, communication and entertainment activities by the students with disabilities. The study also tried to find out the knowledge of use and maintenance by the user and their challenges faced with the current ATs. The study also tried to find out the perception of Students with Disabilities regarding technological advancements for their future needs. The Present study included 30 students (10 Deaf, 10 visually Impaired and 10 Loco motor) with disabilities pursuing higher education. They were interviewed with self-made questionnaire and the response of them were recorded. The results were analyzed and it was found that the students with Visual Impairment were the highest user compared to other disabled. The deaf students are the least user of ATs. The students with visual disabilities use ATs for academic, mobility, communication and entertainment activities whereas students with Hearing Disabilities solely dependent on interpreter and smartphone for fulfilling their basic requirements. The students with locomotor disabilities use ATs basically for mobility purpose. The students with locomotor disabilities have more knowledge towards basic maintenance of ATs whereas 70% students with visual disabilities have the common maintenance knowledge for the ATs. Students with Hearing Disabilities have least knowledge about ATs as they are not using ATs for listening. They only use smartphone for communication purpose and they have the knowledge about basic maintenance of it. The students with disabilities face challenges with the current ATs but they are not aware about its solution. Most of the students are not aware about the technological advancement in ATs and not able to express about their future need regarding ATs. The study found that maximum students are using smartphone but they don't know how to use it for academic activities. The study emphasizes orientation of these students through different exposure programme and workshop for use of ATs in making their life independent.

Keywords: Perception, ATs– Assistive Technology, Higher education, Students with Disabilities

Introduction

Assistive technologies refer to equipment, devices, apparatus, the services and adaptations made in the environment which support and facilitated the functions of persons with disabilities. Technological developments have transformed many aspects the life. The technologies used by person disabilities have significant by change over the course of time (Edyburn, 2001). It has helped to facilitated different skills of persons with special needs who use to struggle in this daily life (Gierrach and Slindt, 2009). In the education process Assistive technology offer various solutions to provide students that meets their needs (McKnight and Davies, 2012). These technologies significantly help persons with disabilities in movement, learning, self-confidence being independent and achieving a high quality of life. Furthermore, these enable students to access education, actively and independently participate in the education process. The use of Assistive Technologies helps to facilitate the improved performances of the students by providing support. In short Assistive technologies have served to increase both the functional and the academic success of the students (Edyburn, 2005; Edyburn, 2006; Alnandi, 2014). United Nation Conventions of the Rights of Persons with Disabilities

(UNCRPD) address Assistive technologies in 9 articles. WHO also recently released a list of Assistive technologies products focussing on equal access. However, there are still many challenges related to the use of Assistive technologies of people with disabilities. These include factors like their cost, access to them, the adequate design and subjective factors like attitude of the society. The objectives of the study was to find out the use of assistive technologies in the academic, mobility, communication and entertainment activities by the student with disabilities at higher education, to find out the knowledge of use and maintenance by the user and their challenges faced with the current assistive technologies and to find out the perception of the students with disabilities regarding technological advancement for their future needs.

The research was conducted through survey technique. Quantitative and Qualitative methods applied to know about the user's perception regarding assistive technologies, which is useful for their higher education. The research was a case study in Dr. Shakuntala Misra National Rehabilitation University Lucknow, which is established by Government of Uttar Pradesh with a mandate of 50% reservation for person with disabilities in each course run by the university. Presently university has seven faculties and twenty-nine departments running from U.G to Ph. D level.

The participants in the present study were 30 students (10 Deaf, 10 visually impaired and 10 Locomotor disabilities) with disabilities pursuing higher education in Dr. Shakuntala Misra National Rehabilitation University Lucknow.

The data collection instrument used for this study was self-made questionnaire, which included 6 open ended questions that were required to be answered in order to complete the survey. The questionnaire was designed to investigate student's perception regarding the use of assistive technology. The tool consisted six statements in which; the statement was regarding various assistive technology used by the student with disabilities particularly by students with Hearing, Visual and Locomotor Disabilities, knowledge of maintenance and use of assistive technologies use by them, activities related to their higher education like academic, social and entertainment, challenges faced by the students with disabilities in relation to their academic and other areas, expectation and need other assistive technologies and their availability for fulfilling their need, knowledge of students with disability about technological advancement in the respective area of disabilities.

Findings

The main findings of this research are as follows -

- The visually impaired students are largest user among all students with disabilities.
- Most of the visually impaired students depend on Assistive Technologies for the academic and mobility purpose.
- 90% of male students and 70% female students with visual impairment use Assistive Technologies.
- 90% of the Locomotor male and female students are using Assistive Technologies for their movement and 50% of male and female students are using academic and communication purpose.
- 70% of male and female with Hearing Impairment are using Assistive Technologies for academic and 80% of male and female are using communication purpose.
- The loco motor students have more knowledge regarding maintenance about assistive technologies.
- 80% male and 60% female students with visual impairment have knowledge of maintenance of assistive technologies.
- 100% of male and female students with locomotor disabilities have the knowledge of maintenance of assistive technologies.
- 70% of the male and female students with Hearing impairment have the knowledge of maintenance.

- 50% of male and 80% female students with visual impairment have the challenges of using sticks while moving from one place to another whereas 50% of the male have challenges in using Abacus and the female students have no challenges.
- 50% of the male and female students with locomotor disabilities have the challenges of using assistive technologies faced many problems and tiredness.
- 70% of male and 80% female students with hearing impairment have challenges in academic activities. 70% of male and female with Hearing Impairment are using Assistive Technologies for academic and 80% of male and female are using for communication purpose.
- 80% of the visually impaired, 50% of students with locomotor disabilities have the knowledge of future technological advancement whereas student with hearing impairment have no knowledge.
- 70% graduation and 50% post-graduation students with visually impairment, 75%of graduation and 50% of post-graduation students have knowledge regarding advancement technology whereas students with hearing impairment have no knowledge about the technological advancements in assistive technologies.

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A Wheelchair in Rural Bangalore: What do the Users think?

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ABSTRACT

It is estimated that currently there are 75 million people who need a wheelchair (1). It has been reported that only 1 out of 10 people that need one actually have one (2). Wheelchairs have proven to increase social inclusion and participation, improve access to education and other social services and better quality of life of the recipients (3). A well-fitted wheelchair reduces the risk of pressure sores, contractures and other complications and thus reduces the total healthcare costs. It is the quality of the wheelchair itself, but also the service through which it is delivered that plays a major role in the outcomes on an individual level. This study was planned with the following research question: What is the current state of wheelchair- and support services and what outcomes are there after receiving a manual wheelchair as perceived by persons with disabilities in Bangalore, India? Purpose: This study aims to investigate wheelchair usability and what the perceived outcomes are after individuals have been fitted with a wheelchair and the quality of service delivery and follow-up services. Methodology: This study used a cross-sectional descriptive design. Data was gathered at one point in time among wheelchair users in Bangalore Rural District. Quantitative data was gathered using QUEST, CHART-SF and WST-Q questionnaires and a VAS-scale. Assuming that 62% of wheel chair users are satisfied about the wheelchair and service delivery program and a 80% CI, the sample size was 39. Quantitative data analysis happened through SPSS version 25 using multivariate linear regression modelling. Informed consent was taken from each participant and ethical clearance was obtained from the Ethical Committees of Bangalore Baptist Hospital and Maastricht University. Results: Data will be analysed using descriptive and inferential statistics; a significance of $p < 0.05$ will be considered significant. Results representing independent and dependent (satisfaction) variables will be presented through a framework. Conclusion: The results will be discussed in terms of possible improvements to wheelchair service delivery considering the user perspective. Considerations that can be derived from both quantitative and qualitative data will be discussed.

Background: It is estimated that currently, there are 75 million people who need a wheelchair (GATE, 2018). It has been reported that only 1 out of 10 people that need one, actually have a wheelchair (WHO, 2010). For low and middle-income countries, the population of people that need a wheelchair and have access to it, ranges somewhere between 2% and 5% (Sheldon & Jacobs, 2008). However, wheelchairs and other forms of assistive technology can be seen as correcting the 'shortcomings of an individual', while from a social perspective assistive technology is considered to be an enabler that reduces barriers in a 'disabling environment'. (Roulstone, 1998) Wheelchairs have proven to be successful in correcting these shortcomings and reducing these barriers, leading to an increase in social inclusion and participation, improve access to education and other social services and better quality of life of the recipients (Shore & Juillerat, 2012). Also, a well-fitted wheelchair reduces the risk of pressure sores, contractures and other complications, and thus reduces the total healthcare costs.

Besides the unmet need for wheelchairs, the shortage is aggravated by the fact that, assistive technology is often supplied without associated services. In general, these include, individual assessment, selection, fitting, training and follow-up to ensure safe and efficient use. These

services have a significant impact on the outcome. (Borg, Lindstrom, & Larsson, 2011) Provision of substandard wheelchairs without associated services, training of users and long-term possibilities of local maintenance and repair has been criticised and can result in dangerous scenarios for users (Pearlman et al., 2008).

This study was planned with the following research question: What is the current state of wheelchair- and support services, and what outcomes are there after receiving a manual wheelchair as perceived by persons with disabilities in Bangalore Rural district, India?

Methodology: This study used a cross-sectional descriptive design. Data was gathered at one point in time among wheelchair users in Bangalore Rural District. Quantitative data was gathered using Quebec User Evaluation of Satisfaction with assistive Technology 2.0 (measures satisfaction with assistive device and related services, QUEST), Craig Handicap Assessment and Reporting Technique – Short Form (measures the degree of disability, CHART-SF) and Wheelchair Skills Test – Questionnaire (measures capacity to perform everyday activities, WST-Q). Assuming that 62% of wheel chair users are satisfied about the wheelchair and service delivery program and a 80% CI, the sample size was 39. In total, 50 current wheelchair users were visited in their homes. They were selected through either a list of current wheelchair users that were receiving government support or through community referral. All house visits were performed with a social worker familiar with the local culture and language. Wheelchair users that used their device for at least six months were included. All participants signed informed consent. Under-age participants or mentally incapacitated participants were accompanied by a parent or relative.

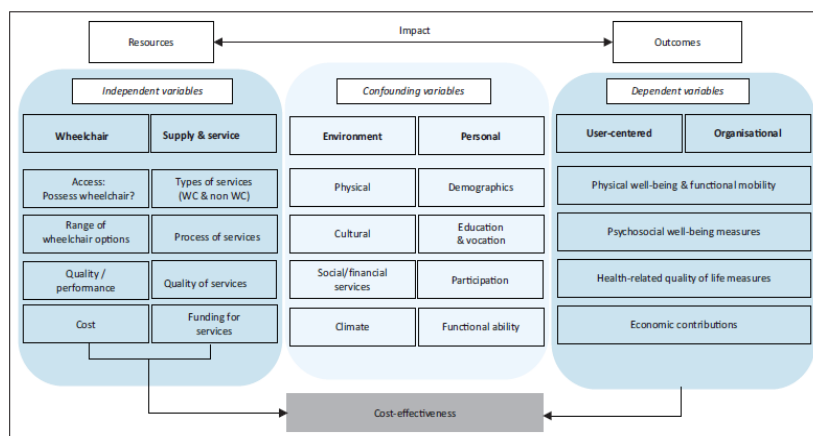


Figure 1. Conceptual framework illustrating the factors that affect wheelchair provision. Source: Kamaraj et al. (2017)

Results: 50 wheelchair users were interviewed in their home environments, their demographics were described in table 1. Wheelchairs being used by the sample were hospital-style manual transport wheelchairs (n=17), tricycle (n=16), motivation wheelchair (n=15), and paediatric wheelchair (n=2). Outcome measures of the questionnaires were calculated (table 2). On average female wheelchair users were less satisfied with the wheelchair and support services ($p>0.05$), had higher rates of disability ($p>0.05$) and were less capable in wheelchair skills than male users ($p<0.05$). Female wheelchair users named *easy to use* [the wheelchair], *comfort* [of the wheelchair] and *effectiveness* [of the wheelchair to meet their needs] as most important aspects of wheelchairs and support services. Male subjects named *dimensions* [of the wheelchair, size red.], *easy to use* [the wheelchair] and *repairs/servicing* [provided for the wheelchair] as most important aspects of wheelchairs and support services. Both male and female wheelchair users were less satisfied about the support services (3.73 and 3.59, $p>0.05$) than the wheelchair itself (3.79 and 3.75, $p>0.05$). Wheelchair users with a higher degree of physical disability (meaning they were less independent) had significant lower satisfaction related to the wheelchair ($p<0.05$) but this was non-significant for support services ($p>0.05$) Twenty-two subjects (**44%**) indicated no follow-up visits were done after wheelchair delivery for both government and private services. The average satisfaction for male wheelchair users were less than the average of the study population (3.58 vs 3.80) while for female users satisfaction was slightly higher than average (3.77 vs 3.70). However, all wheelchair users that didn't receive follow-up rated lower satisfaction scores for the support services (3.47 for males and 3.46 for females) than the wheelchair itself (3.55 for males and 3.77 for females). Male wheelchair users that didn't receive follow-up were less capable of performing daily activities with their wheelchair with this score being, on average, 44.88. Female

wheelchair users that didn't receive follow-up score slightly higher than average with 41.75. The skills a wheelchair users had were strongly correlated with satisfaction scores ($p < 0.01$). Ten subjects lived under the international poverty line which is significantly correlated ($p < 0.05$) with QUEST outcomes. A multivariate linear model was build using independent variables that were significantly related to the dependent variable (satisfaction score). The first model was built according to the framework presented in figure 1, with variables being placed as either independent, confounding or dependent. Because of multicollinearity in the model the following variables were removed: *wheelchair usage*; *CHART-SF*; *WST-Q confidence sub-score* and *WST-Q capacity sub-score*. A second model was tried using a stepwise forward method which gave a second, seemingly better, model (table 4). The eigenvalue for the second model was 5.712, indicating less collinearity among the independent variables. With a *R square* of 0.511 the presence of the independent variables would explain 51.1% of satisfaction towards assistive devices and support services.

Conclusion: Currently the average satisfaction for the wheelchair services in Bangalore Rural district can be described as *more or less satisfied*. This satisfaction is strongly influenced by the presence, or absence, of adequate support or follow-up services, the skills an individual has to perform everyday activities and the degree to which this person is disabled, especially in terms of economic (in) dependency. The results from this study suggest that more effort is needed on the wheelchair services rather than the wheelchairs themselves. Both male and female subjects mention *easy to use* (in terms of having the skills to be independent), *comfort* (in terms of having a well-maintained wheelchair) and *repairs/servicing* (in terms of having access to these services that are close to their houses) as important parameters for being able to successfully use their wheelchairs. Not only should wheelchair services be aimed at providing an adequate wheelchair and provide maintenance and support, it should also provide the users with training. The importance of having adequate wheelchair skills towards one's satisfaction on the wheelchair has been proved and thus should be considered as well by those designing, managing, funding and implementing wheelchair services. During the house visits one subject said '[I] think follow-up services are really important, especially for the poor'. This was said by a well-off wheelchair user and is something to consider. Although, especially government services, are inclusive to everyone with disregard to their personal situation, people from a poor background and/or environment are especially at risk for inadequate use of the wheelchair and its services. This potentially disables the impact these services have to improve the lives of the very people it aims to serve and prevent worse health outcomes in the poor.

	QUEST		CHART-SF		WST-Q	
	Male	Female	Male	Female	Male	Female
Mean	3.8	3.7	456.55	440.50	53.11	37.00
Std. dev.	0.71	0.87	84.03	115.11	20.52	14.04
Minimum	2.33	1.33	258.02	230.60	0.00	2.69
Maximum	4.92	4.58	586.63	584.42	80.56	58.59
Pearson's	-	-	.093	.283	.506	.565
Pearson's p-value	-	-	0.602	0.289	0.002	0.023

Table 2. Average outcomes measurement tools.

Variable	Effect on satisfaction		
	Adjusted <i>b</i>	95% CI	Sig. (p-value)
WST-Q confidence subscore (confidence in wheelchair skills)	1.12	0.10-0.73	<0.05
CHART-SF mobility (degree of disability in relation to functional mobility)	-0.44	-0.024- -0.007	<0.01
CHART-SF (total degree of disability)	0.275	0.004-0.670	<0.05
WST-Q capacity (quality of wheelchair skills)	0.249	-0.28-0.47	ns.
WST-Q performance (how often skill is done)	-0.851	-0.070-0.007	ns.

Table 3. Multivariate linear regression analysis for determinants of satisfaction on wheelchair services

Demographic	n	%
Gender		
Male	34	68
Female	16	32
Age		
< 25	7	14
25 – 50	28	56
> 50	15	30
Cause of disability		
Cerebral Palsy	5	10
Polio	15	32
Amputation	7	14
Spinal Cord Injury	8	16
Accident	3	6
Hemiparesis	4	8
Congenital Birth Defect	3	6
Other	4	8
Education		
Illiterate	11	22
Primary education	26	52
Secondary education	10	20
Professional education	3	6
Currently employed		
Yes	18	36
No	32	64
Previously employed		
Yes	18	36
No	32	64
Marital status		
Single	25	50
Married	20	20
Widow	5	5
Household size / type		
<=5	31	62
>5	19	38
Joint	34	68
Nuclear	16	32
Wheelchair source		
Government	34	68
Private	16	32
Wheelchair usage		
Self-use	36	72
Proxy-use	14	28

Table 1. Baseline demographics of the study population (n=50)

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Speaker Presentations Day 2

Gaze-based Assistive Technologies

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ABSTRACT

Persons with motor disorders such as cerebral palsy or amyotrophic lateral sclerosis often show significant communication impairment due to limited or absent speech and co-existing cognitive, sensory, and social deficits. In addition, motor impairment can restrict the use of movement, including pointing, to signal interest and intent. This leads to reduced participation in family and community life, activity limitations and increased caregiver stress. The eyes play a crucial role both in perception and communication. Technical interfaces that make use of their versatility can bring significant improvements to these persons. Using the eyes to enter texts into a computer system, which is called gaze-typing, is the most commonly used gaze-based assistive technology (GBAT). GBAT is rapidly developing and is now used in the household or outdoors and not just confined to interactions with desktop-computers. GBAT has the potential to enable these persons to perform recreational activities, such as to play games, make drawings, for literacy training, internet surfing and to interact with others. Other individualised and important goals for GBAT are controlling air conditioning, music, television and other physical aspects of the environment. GBAT allows a person to engage with objects on a screen by moving only their eyes. The system involves a specialised infra-red video camera mounted on a tablet or personal computer. As the person sits in front of the GBAT control system, sophisticated image processing software analyses the camera's image of the eye/s and determines where the user is looking on the screen. The computer tracks the eye movements, which in turn control the cursor on the screen. The person selects items either by holding their eye-gaze for a certain time, referred to as 'dwell', by blinking, or by clicking an external button. Presently, GBAT is expensive and time consuming to implement. Further clinical evidence is needed to guide selection of appropriate potential users of GBAT and to accurately match technology options with the user to optimise successful implementation and minimise device abandonment and wastage of resources. Our experiences of using GBAT such as Samsung EyeCan+ and Glassouse will be presented.

My talk is on gaze-based Assistive Technologies (GBAT), which I will present along with my Occupational Therapist, Yash Gupta. Eyes play a crucial role in both perception and communication. Persons with Cerebral Palsy (CP) or Amyotrophic Lateral Sclerosis (ALS) show deficit in speech. Using eyes to enter texts into computer system, called gaze-typing is the most common gaze-based AT. GBAT helps disabled persons use only their eyes to operate technical devices e.g. PC/laptop/handheld devices/tablets/mobile phone).

RECOUP is a tertiary level muscular rehabilitation centre, we use 4 devices. Samsung's EyeCan+ was donated to us by Samsung, Korea for clinical trials. Configuration specific to the user is time consuming and technically challenging. Glassouse (like big spectacles) is a head-mounted device and uses head movements to operate devices. Besides regular use, it can help improve communication and interaction and trunk control of the PWD. Games are possible on it. EVA facial mouse (Camera mouse) can control the mouse with head nods, eyes. It is cost-effective and user friendly.

Devices like Oculus Rift and VR head Gear devices helps play games, watch videos, map locations and uses AI, and helps a person with severe CP. There are 3 phases involved: training the PWD, device mastering and application/execution. Using GBAT helps improve social interaction and communication and head and trunk control and balance.

Computer activities are more possible for children who use GBAT. In trials done, all had attained goals, and parents were satisfied. GBAT provides children with important opportunities for learning, play and communication. However, research regarding this is sparse, and further research is required to estimate its clinical utility and efficacy in various group of subjects.

RECOUP has developed customized games for rehabilitation therapy, not to be used as regular online games, as this could lead to problems. No study has been on autistic children so far. We need to calibrate the gaze distance for each user, and it takes quite some time. It calls for the user to maintain a steady gaze otherwise they cannot use this technology.

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Innovative Assistive Technology Solutions

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ABSTRACT

According to the World Health Organization's World report on Disability 2011¹, 15 percent – about 1 billion people – of the World's population lives with some form of disability, of whom 2-4 percent experience significant disabilities in functioning. The World report on Disability mentions that disability disproportionately affects vulnerable populations. Also, to add, results from the World Health Survey indicates that there is a higher prevalence of disability in people from the low-income countries and the poorest wealth quintile.

Persons with disability stumble upon several barriers and challenges to good quality of life, including inadequate policies and standards, and poor implementation and enforcement of existing policies and standards. Beliefs and prejudices constitute barriers to education, health care, and social participation.

The lack of rigorous and comparable data on disability and evidence on programs impede understanding in the Indian context. As stated in the 2011 Census which provides the latest and definitive statistics in India on the Persons with Disabilities (PwDs), around 2.68 Crore people, which roughly amounts to 2.21 percent of the total population, are disabled. And, the startling fact is that only about 16 percent of the disabled population had acquired any assistive devices and aids².

Assistive technologies include any item, piece of equipment or product used to increase, maintain or improve the functional capabilities of people with disabilities. Assistive technologies include low-vision devices, hearing aids, augmentive and alternative communication systems, walking frames, wheelchairs and prostheses such as artificial legs. In addition to low-cost, simple products, more advanced solutions exist, such as screen-reading software, customized telephones and computer-assisted devices. These technologies also have socioeconomic benefits, by reducing direct health and welfare costs, enabling a more productive labour force, and stimulating economic growth. They can enable people with difficulties in functioning to live independent, productive, healthy, dignified lives.

It is well recognized that the need for the assistive technologies is high but demand is low, and supply is even slower, especially in low- and middle-income countries. The demand – supply gap itself presents a challenge to improving access - which is one of the most important factors to be considered when the merits of assistive technology are evaluated. Challenges to improving access stem from low production which in turn paves way for low availability – another factor that merits assistive technologies. Despite high levels of need, lack of awareness results in lack of demand, which in turn impedes research and development and adoption.

The World Health Organization initiated the '**Global Cooperation on Assistive Technology (GATE)**' program as a platform for international collaboration across governments, UN agencies, NGOs etc. to incentivize development of assistive technologies, devices and aids that are affordable for adoption in developing countries.

¹ https://www.who.int/disabilities/world_report/2011/report.pdf

² Social Statistics Division, Ministry of Statistics and programme Implementation, Government of India. "Disabled Persons in India, a statistical profile 2016".
[http://mospi.nic.in/sites/default/files/publication_reports/Disabled_persons_in_India_2016.pdf].

In India, in recent years much has been done by the Government and its various institutional mechanisms to support the disabled population in India. India had formulated its first National Policy for PwDs in 2006 and it was followed by an **Accessible India Campaign** which was launched in 2015. Also, NITI Aayog, India's policy think-tank initiative of the Government drafted a three-year **Action Plan for PwDs** in 2017³. The main objectives of the Action Plan were:

- Undertaking Legislative, Policy and Institutional Reforms
- Estimating the number of PwDs in India
- Improving accessibility
- Strengthening education
- Enhancing employ ability
- Improving access to Aids/Assistive technologies

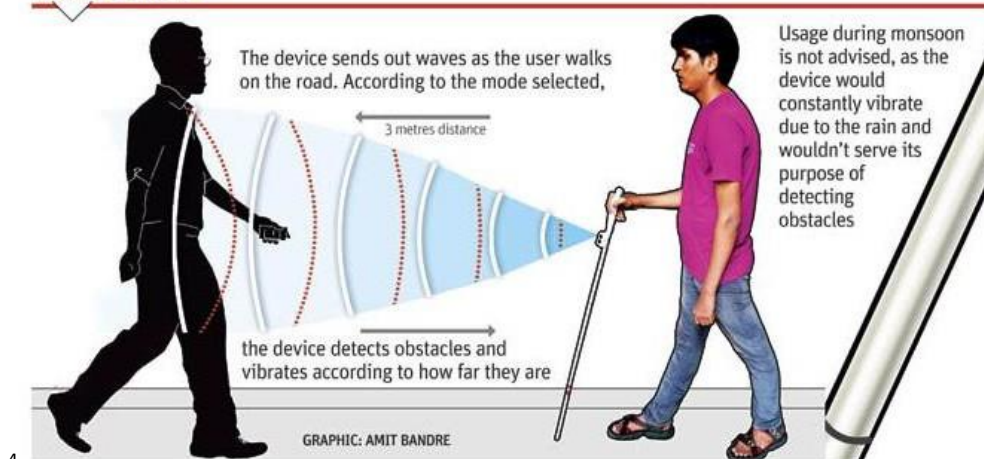
The Department of Biotechnology (DBT) funds research and development of assistive technologies in collaboration with various institutions in India and abroad. Some of the prominent projects are with academic institutions like IIT-Kanpur, IIT-Delhi etc. Recently the Biotechnology Industry Research Assistance Council (BIRAC) – a Govt. of India Enterprise under the aegis of DBT, Social Alpha – an initiative to strengthen the Science & Technology startup ecosystem and Mphasis – an IT Services company launched the BIRAC- Social Alpha Quest for Assistive Technologies.

Another landmark initiative titled “**Affordable Healthcare in India**” funded by the Wellcome Trust, UK has funded and developed several assistive technology products such as **SmartCane®**, **DotBook (Braille Laptop)**, **Standing Wheelchair** (to be launched soon) etc.

The **SmartCane®** helps the visually impaired by enhancing the normal white cane's capability by detecting objects from knee to head height in front of a person. It uses ultrasonic ranging to detect obstacles, and conveys distance information to the end users through distinct vibratory patterns and helps users to avoid collisions with over-hanging and protruding objects, such as tree branches, signboards, underside of parked vehicles, open glass windows, thereby enabling them to navigate in different social settings with safety and confidence.

³ <https://enabled.in/wp/niti-aayogs-three-year-action-plan-for-persons-with-disabilities/>
Proceedings of National Conference on Assistive Technology for All AT-2030

How it works



4

The **DotBook**, a feature-packed, ergonomic & **affordable refreshable Braille display**, built on IIT-Delhi's patented Shape Memory Alloy technology is aimed at creating an independent access to digital content for the visually impaired. By addressing issues such as social inclusion and creating equal opportunities in education & employment, the DotBook is sure to create a positive impact for the visually impaired community, where hassle-free, independent access to the digital world has emerged as a key factor in everyday living, education and work.

dotbook

India's First Braille Laptop

“ We are proud to announce the launch of DotBook - an Affordable, Feature-packed & User-friendly Refreshable Braille Display. DotBook has been developed to enable easy access to digital content for the persons with visual impairment.

India's First Braille Laptop was launched at IITD for visually impaired.

5

The **Affordable Standing Wheelchair** being developed by IIT-Chennai's Rehabilitation Research and Device Development (R2D2) lab will be a boon to people with locomotor disabilities. The persons with locomotor disabilities may have to use a wheelchair for their entire life wherein the user spends time in a seated position all the time. This hurdle gives rise to many physical as well as mental health related issues such as sore body, building of pressure points leading to pressure sores, lowered blood circulation, and dependence on other people for basic needs. One solution to this problem is to provide mechanisms in the wheel-chair to assist the person to stand and the Standing Wheelchair provides reclining mechanisms and options to stand on their own assisted by the Wheelchair.

⁴ <https://www.stumagz.com/in/iit-delhi-develops-smart-cane-for-visually-impaired-/>

⁵ <http://assistech.iitd.ernet.in/>



The principal research and development strategies for providing assistive technologies are guided by the 5A & Q principles – which are Availability, Accessibility, Affordability, Adaptability, Acceptability and last but not the least Quality. As outlined above, the Indian health system and the interlinked entities through various Government departments such as DBT, Department of Health Research (DHR) and their allied institutes are helping the numerous Indian innovators working in the Assistive Technology space, in the design and manufacture of low cost affordable assistive aids and devices to ensure that each and every disabled has access to quality assistive technologies so that they could flourish and become productive members of the society and the world at large.

Human Resource Development and Assistive Technology

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ABSTRACT

A physical disability can affect how a student performs in the classroom. Advances in technology and supportive legislation can help a student with physical disabilities succeed. Technology can be a great equaliser for people with disabilities allowing them to get around a limitation in any number of areas. There are a variety of types of assistive technologies which include wheelchairs, canes, prosthetic devices, orthotic devices, cognitive devices, and adaptive switches among others. Assistive technology service providers may specialise in several areas including job accommodation, computer accessibility, vehicle modifications, architectural and home modifications, augmentative and alternative communication, environmental controls, positioning devices and seating and mobility devices. Assistive technology can be very effective in helping students improve their functional ability in the classroom. With the advancement of new technology, students with physical disabilities, now have the opportunity to participate and be educated in the regular education setting. As each student's need is different, an assessment must be completed to determine which device is best suited for that student.

Among others, I am a Member-Secretary of the Rehabilitation Council of India. There is nothing new in this talk for you. We are all aware that human resources are needed to reach the PWDs to use it safely and effectively. The 71st World Health Assembly adopted a resolution on AT. Member states are to develop, implement and strengthen policies and programs to improve access to AT. Currently, 1 billion people globally need AT and the numbers will rise to 2 billion by 2050. 90% of people who need it do not have access to it. The ultimate aim of Sustainable Development Goals 2030 is to "leave no one behind". AT ranges from the simple to the most complex. It includes modified vehicles, ramps, wheelchairs, low-floor buses. From medication reminders, alarms, timers, watches, recorders, flash cards, communication boards, magnifying glasses, glasses, hearing aids, feeders, page turners to environment control units. It can range from small devices for buttoning a shirt to walking, using a computer keyboard, and so on.

AT enables and promotes inclusion, participation and engagement of PWDs, an ageing population and people with co-morbidities. But we are a long way off from the ideal situation. We can improve the situation by improving access to AT. The enabling environment which the person needs to be able to use AT is lacking in many places. The heart of the whole thing is to ensure adequate trained human resources for provision and maintenance of products to use them effectively. ATs useful for PWDs but also for the aged, so universal design (UD) is to be aimed at. We need to develop a national list of priority AT products. We need to promote an inclusive barrier-free environment.

PWDs are a valuable human resource which itself can promote, help and design more ATs. It is rightly said that 'For most people, technology makes things easier but for the person with disability, it makes things possible.' The actualization of their potential will happen only with family/carer support.

Assistive Technologies in Universal Health Coverage

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ABSTRACT

The paper highlights the relevance of introducing ATs in Indian health system in incremental manner with intent to make it essential part of health system with intent to complement/supplement national efforts to achieve UHC by 2030.

For doing so, the paper outlines standard inputs, mandatory processes, essential partnerships at research, technical and business level against the backdrop of situational analysis, SWOT analysis so that country suited list of essential technologies are prepared, they are manufactured indigenously/ or imported against bilateral/multi-lateral agreement, its R&D promoted leading toward product development and India become largely import free for essential technologies by 2030. It tries to measure gaps and suggest a possible pathway for making ATs available at all level in Indian health system, without any availability failure, accessibility problem and quality compromise.

A systematic presentation through context, policy, regulation, situation today and SWOT analysis has provided enough basis in this paper to suggest a possible way forward, which is sustainable response to fill this public health gap. It will create a win-win solution for all partner-researcher, manufacturer and investor on one hand and boost up for public health, employment, social justice, MSME, Industry and economy sector for India. On the other hand, it advocates no new program/scheme but only new policy direction, partnership, and scientific approach for making ATs of high quality available, accessible and affordable in In India.

AT in the Era of AI: How Advanced Technology is Influencing New Designs

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ABSTRACT

Assistive Technologies enables seamless integration of the differently abled population of the society. The engineering devices need to integrate and interact with the physiological system, the human body, to effectively deliver the functionality. Short-term functionality to long-term acceptance of assistive devices is challenging due to the dynamic nature of and incomplete knowledge about the expectations from and consequences of use of the devices; good products of today are inadequate tomorrow. Hence continuous technological advancement of assistive technology is imperative. Democratization of advanced technologies such as AI and IoT and specialized interventions such as Targeted Muscle Reinnervation has led to innovations unimaginable a decade ago.

In this paper recent trends in the development of assistive systems especially for the limb-prostheses are presented to highlight the potential of high-end computation and algorithms towards making the prosthetic systems dexterous, smarter and extremely easy to control. This transition from body-powered arm or simple stilt to mind controlled 10 d.o.f arm or AI-powered autonomously grasping hand are also analyzed in the context of AAAQ (Availability, Accessibility, Acceptability and Quality) of AT to examine potential of these novel systems for bringing about change in life of the users in general. Then the salient features of a trans-radial prosthesis and a transtibial ventilated socket are discussed in the light of technology vis-à-vis the desirable attributes.

This opportune time when technological barriers are getting removed, need for a systematic design methodology for assistive devices that are mass customizable is strongly felt. The author's ongoing research towards development of a framework for mapping the user's available ability to the desired set of activities of daily living, via design interventions, will be briefly presented with illustrative examples.

Talking in front of this august gathering, I feel I am showing a lamp to the sunlight! I do product design and manufacturing. Today I will tell you about some basic explorations I did on one prosthetic device to make it better. Despite development of so many hi-tech devices, these are not available to a lot of people. So, this presentation is an attempt to understand and also to see where this new wave of technologies of AI or machine learning come into the space of ATs. I wanted to check through a few examples of how the development of these technologies are influencing the assistive devices (ADs).

In India, we want to say, we did it first. There were functional prostheses even in the era of the Vedas. The Rig Veda mentions that the Aswins (physicians to the gods) gave Vishapala, wife of King Khela, a metallic leg after her leg was cut off in an engagement by night. It is mentioned so casually and in passing that it seems like it was commonplace. It was about a functional prosthesis, but there is no material evidence! Egyptologists from the University of Basel in Switzerland have re-examined an artificial wooden big toe. The find is almost 3000 years old! Discovery in a tomb in Turpan, China showed that a man of modest means who lived there 2,200 years ago had a deformed leg, and compensated with a prosthesis of horse hoof on the end of it. There are more

modern cosmetic prostheses available from 70 years ago. So where are we going? Advanced prostheses imply mechanical, plus electrical, plus electronic hardware. Dexterity is derived from multiple motors. The challenge is mostly electrical: how to transfer 'intention' from the bio-signals, and how to coordinate multiple motors from a limited and noisy bio-signal. As against this, the smart/intelligent prostheses imply software: hardware, plus algorithm, plus computation. The challenge is how to avoid gathering bio-signals or how to make the device intelligent, i.e. behave as it should rather than as it is told to. There is the opportunity to leverage technology via Artificial Intelligence (AI)/Machine Learning (ML) and data sciences.

Today we have smart, intelligent prosthetic devices that create natural motion by predicting movement. Professor Helen Huang has developed a joint bio-medical engineering program at North Carolina State University and the University of North Carolina at Chapel Hill; her colleagues developed a user-generic musculo-skeletal computer model of the human forearm, wrist and hand. Using the data from signals sent from volunteers fitted with electromyography sensors (sensors that record electrical activity in muscle tissue), they created their computer model – somewhat like a software middleman between a wearer and his prosthesis. The program is trained using normal users and minimizes the training requirement for the prosthesis users. This will hopefully make the interaction robust and intuitive.

A bionic hand that can 'see' objects and pick them up by itself, developed by biomedical engineers at the University of Newcastle, UK, has won a prestigious 2018 Netexplo UNESCO award in Paris. Now the focus is on hardware, dexterity from multiple motors, to avoid bio-signals, and the opportunity to leverage AI/ML technology, data sciences. These make the systems extremely easy to use. Smart prosthetic devices create natural motion by predicting movement. Smart prosthetic ankles take out the fear of rough terrain/surfaces/steps/slopes.

We have developed a robotic hand in IISc, Bangalore. The old wired prosthetic arm now replaced by the electric arm which is lighter and has one reasonably powerful motor. However, the new one is not electrical but myo-mechanical. Instead of 5 motors earlier (in conventional designs), now there is only one motor, controlled by patterns of twitching of the forearm muscles. It can grasp varied shapes and sizes. It requires virtually no training; user trials on about 50 subjects from different parts of India has recently concluded. Even the most advanced prosthesis systems, which use targeted muscle reinnervation (TMR) technique, an elaborate surgical procedure, needs rigorous training for the user. It has taken millions of dollars and about a decade to develop, and now is likely to be available for one million dollars. Mind-control devices are available today but are not available for the actual users!

To make technology truly useful, we need to make them appropriate for the users' requirements. Ability – manipulation – activity is a framework we have been working with to systematically map motion and manipulation requirements of activities to the technical requirements of a device. The procedure can also give us certain activities which we can perform with a given technical specifications of a prosthetic arm. With better understanding of AI and ML, physical interfacing of people can be managed. With ML the device can gradually learn from its usage and eventually it will become virtually the own hand of the amputee.

We are now working on a comfortable tibial socket. The current snug-fit total contact socket leads to problems such as distal stump oedema and haemorrhage, contact dermatitis, eczematization of distal skin, fungal infection, rashes and thickened skin. Advanced socket designs avoid the snug-fit, provide space, support and air-flow. Alternate ideas have refined our design and a prototype has been tested in Mobility India. The patenting process is in progress, on completion of which more details can be shared.

As technology develops further in coming years, we believe that the ambiguities and complexities of interfacing with the user will become irrelevant as more autonomous systems and collaborative-robotic prosthesis takes us to a new era of ability-restoration through design.

Independent Walker for Diplegic Cerebral Palsy Children

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ABSTRACT

Cerebral Palsy individuals with gross motor factor of level 2 and 3 needs a way to improve their postural balance and walking stability making them to walk independently. Spastic diplegia, a form of cerebral palsy is a neurological syndrome where the person happens to have increased muscle tone, making their legs stiff and thus affects their walking pattern. With all these difficulties the patients tend to depend too much on care takers to even perform simplest of the activities. Children between 7 to 12 years are considered as the best period to concentrate on physical therapy to improve their mobility function. Currently available walkers do not adequately develop lower body strength as the Children depend too much on the walker and support their body weight on their hands and arms, reducing the necessity to bear weight and walk. By developing Independent walker with rotator wheels, patients can manage their posture and practice walking to maximize their potential, which will eventually increase the confidence. The methodology includes analyzing the patient's walking pattern and their posture, with respect to the data collected, A 3D model was designed using SOLIDWORKS to validate the geometry of the model virtually and further helps to interpret the dimensions. This is followed by strength and stability analysis performed on Ansys software as it is important to predict the way the product reacts to the external forces, vibration and physical effects. The walker holds the feature of being easily adjustable to fit average child between the ages of five to eleven. The material for the fabrication is comparatively less in weight and non –corrosive for long term use. The wheel used is rotator type, with the properties of variable speeds and high lifetime of the mechanics. These wheels will facilitate linear motion to prevent back fall.

Introduction

Spastic diplegia is a form of cerebral palsy, a neurological condition that usually appears in infancy or early childhood, and permanently affects muscle control and coordination. Affected people have increased muscle tone which leads to spasticity (stiff or tight muscles and exaggerated reflexes) in the legs. The arm muscles are generally less affected or not affected at all. And hence, children with spastic diplegia will find it hard to maintain the posture and stability while walking. Above the child's hip, it usually retains average muscle tone and range of motion. It's the lower extremities that are affected at a higher degree. It is a permanent disability.

However, the disability can be improved by proper physical and occupational therapy. Children between 5 to 12 years are considered as the best period to concentrate on therapy. Available walking and posture balancing models for CP patients are more expensive than most of them can afford, thus a supporting device with an affordable cost to help the children to walk is needed.

Problem Statement

Spastic diplegia patients have tough time to balance their posture and to lead a normal life, patients are always in need of a person to support them in walking and thus it's painful for both patients and care takers.

Aim

To develop a mechanical walking model to balance the posture of spastic diplegia patients thereby, to improve the walking pattern of patients with gross motor function levels 2 & 3.

Background

The objective of the device is to encourage independent walking; currently available walkers do not adequately develop lower body strength or proper walking technique. The children depend too much on the walker and can support most of the body weight on their arms, reducing the necessity to bear weight with their legs and walk. And hence this does not help in walking practice.

Objectives

- To analyse mechanics of lower extremities of spastic diplegia patient walking pattern, body alignment, stability, posture balance
- To sketch a mechanical model in solid works to analyse the efficacy of the designed model
- To test the designed model in ANSYS software with respect to toughness, materials, strength, mechanical efficiency

Conceptualization of the Assisting Walking Model

The main conception is to provide a walking model that can be used by children between 4 to 12 years (Children with GMFCS level (ii) and (iii)) in specific environments, preferably home and rehabilitation centres. This model is designed:

- To motivate movements and to keep stability
- To make walking less energy consumption
- To improve posture alignment
- To maximize the potential for walk
- To improve the gross motor level (from level 3 to level 2)

Parameters that was Considered for Designing a Model

- Walking patterns of CP patients (by collecting data of children with diplegic disorder)
- Size and type of the wheel
- Surface of the environment where the device is intended to be used
- Weight of the load it can support
- Flexibility range of the trunk

Study on Cerebral Palsy Patients

When Cerebral palsy patients were observed, there were impairments associated with weakness or under activity of the anterior tibial muscle relative to over activity of the gastrocnemius and soleus muscles. Their movements are stiff, jerky and uncertain. It was also observed that they certainly need a support around pelvic and thoracic region for stability when they try to walk. Even to perform slightest of the movements they need someone to hold them around their abdomen which is painful for both the care takers and the patients. The walking pattern of these patients varies with respective to many factors like age, other associated deformities, gross motor level.

Methodology

Firstly, the motion analysis of diplegia CP patients is done with help of the data collected with respective to their motion, a 3D model of walking device is designed using solid works to validate the geometry of the model virtually. This quickly allows making changes, solving design problems and economically constructing the products. Dimensions are taken with the help of different prototype technique. Testing of model is done using ANSYS software. ANSYS software is used to simulate interactions of all disciplines of physics and structural. It is important to predict the way the product reacts to external forces, vibration and physical effects.

Mechanical Model

It is necessary to design the walker easily adjustable to fit average child between the age five to eleven, and easily storable when not in use. Furthermore, it will be designed in a way that it does not weigh more than (10.4 kg). The materials used are non-corrosive to ensure longer life.

Functional Electrical Stimulation for Drop Foot and/or Knee Instability

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Stroke is one of the leading causes of death and disability in India¹. Multiple Sclerosis, although the incidence rates in Indian population are not established, is a complex clinical condition adding to the number of people with disability in India². A devastating residuum of both these conditions is foot-drop. Foot drop affects locomotion and increases chances of fall leading to loss of confidence, reduced mobility and lower social participation. Functional Electrical Stimulation is a recent technology to treat stroke, but its use has stayed limited mainly due to the complexity of use and costs. The current generation of FES devices are simpler and much more effective in treating foot-drop. In this paper, I will explain about the current generation of FES devices, their applications, key benefits and role in different stages of the disease. I will also explain briefly about other modes of orthotic rehabilitation for other afflictions. A better understanding of this treatment modality should help make it more widely accepted, and eventually should help bring down the costs of treatment.

The right device for every user

The L100 and L300 Go (Leg Device) were designed for users with drop foot and are based on the principle of functional electrical stimulation (FES). The L300 Go also provides support for instability of the knee. Depending on the user's needs, the L300 Go is available as an independent lower leg system, as a combined lower leg and thigh system and as an independent thigh system that uses a foot sensor. The L100 Go system is available only as an independent lower leg system with single-channel stimulation. Thanks to 3D motion detection, multi-channel stimulation (L300 Go only), Bluetooth programming and a user app for smartphones, this system offers impressive end-to-end features.

L100 Go system | 28FS100

The L100 Go is a single-channel system. This version is a useful treatment option for users for whom adequate physiological dorsiflexion is possible with single-channel stimulation and who have no additional instability of the knee or weak thigh muscles.

L300 Go | 28FS300

The L300 Go is a multi-channel system. This version is a useful treatment option for users for whom adequate dorsiflexion is not possible with single channel stimulation and who also have instability of the knee or weak thigh muscles. The L300 Go controls the amount of dorsiflexion and inversion/eversion precisely with just a single electrode. A new learning algorithm adapts to changes in gait dynamics. Movements are monitored in all three planes.

Benefits at a glance

- Fast, intuitive fitting for the therapist/technician
- Multi-channel stimulation (L300 Go only) and single-channel stimulation with just one electrode
- Reliable 3D motion detection
- Optional foot sensor and remote control (L300 Go only)
- Analysis of results with an integrated 10-m walking test
- Optional surface stimulator for additional knee instability (L300 Go only)
- User app for control and measuring activity

H200 Wireless system (Hand Device)

Seizing life. This hand orthosis uses electrical impulses to activate the nerves controlling the muscles in the hand and forearm which the central nervous system can no longer control due to damage. The H200 Wireless can improve the hand's active range of motion and train corresponding muscles so that they work again, even without the system. It is possible to use the H200 Wireless both for training purposes and for making simple gripping movements in everyday life. Seven modes are available – three functional programs for everyday activities and four therapeutic programs. Of these modes, a total of two movement patterns can be saved to the control unit – individually adapted to the needs of the user.

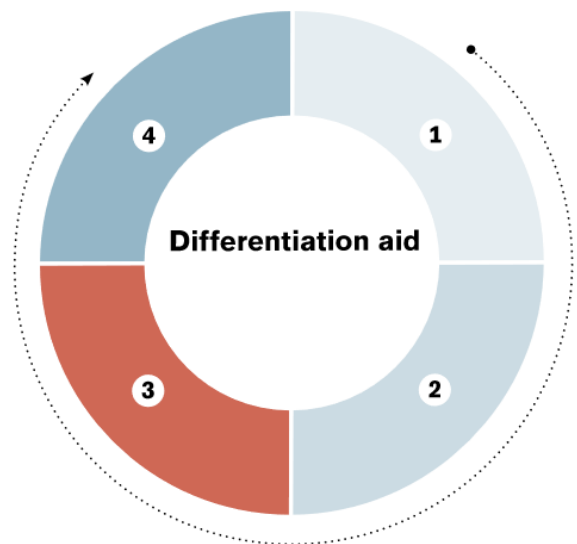
Benefits for the O&P professional

- Easy to adjust the modes and intensity via a tablet
- Electrodes are easy to position thanks to panels with standard settings
- Lightweight, ergonomically shaped orthosis
- Handy control unit for wireless communication with the orthosis
- Can be applied with one hand
- Provides support for movements in everyday life
- Targeted training for specific muscle groups
- Supports the reduction of muscle spasms
- Contributes to improved blood flow
- Can prevent atrophy

Make the selection based on the following points

1. Case history

- Examine the patient closely and speak with them about their expectations. Determine whether they had any prior device and, if so, what type.
- This will reveal the following aspects:
 - Has the patient had any previous orthotic fitting? Were they satisfied/dissatisfied with this fitting?
 - If the patient has been treated with FES before, did they have a good experience with it, and are they able to use a FES system? This will determine whether FES system is appropriate for them in principle.
 - Has the patient not yet been treated with FES, and were they previously fitted with an ankle-foot orthosis?
 - You will first need to test whether the patient responds to FES at all.



2. Muscle status measurement according to Janda

- Measure your patient's muscle strength and determine whether there is isolated dorsiflexion weakness or whether other muscle groups are also affected, such as the plantar flexors.
- Possible result A: Only the dorsiflexion muscles are affected – there is a relatively high likelihood that the L100 Go single-channel system will function satisfactorily. A functional

test and gait check will be needed to indicate whether the L100 Go is sufficient as a treatment option.

- Possible result B: Several muscle groups are affected, which means dorsiflexion will not be sufficient for a physiological gait pattern on its own. As a result, eversion and dorsiflexion can be controlled separately using the two-channel system. A functional test and gait check will be needed to indicate whether the L300 Go is the right treatment option. If other muscle groups that impair the knee-extending or knee-flexing musculature are affected and, for example, trigger a genu recurvatum, an upper leg cuff can also be used to produce a proper gait pattern (L300 Go Upgrade system).

3. Functional test

- You do not need both systems to test and make a distinction between the L100 Go and L300 Go. Simply put an L300 Go with Quick Fit electrodes on the patient, and if you can stimulate physiological dorsiflexion while the patient is walking, the L100 Go single-channel system should be the right fitting.

4. Outcome

- Insufficient dorsiflexion is still present if the foot deviates medially or laterally in the swing phase and there is a danger of a supination trauma during heel strike. Furthermore, there should be no negative impact on a neutral knee position in A-P in the area of the knee joint during walking and standing. However, if you observe any of the aforementioned, the L300 Go should always be used. The major advantage of the L300 Go is the differentiated control of the muscles, which also allows compensation for deviations in the frontal plane in the foot. We also recommend considering the addition or application of an Upgrade system, which can optionally influence the knee-flexing or knee-extending muscles.

Enabling Fabrication of Prosthetic and Orthotic Devices with Additive Manufacturing via Digital Transformation

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ABSTRACT

The Census of India 2011, shows that there are 26.8 million persons with disabilities in the country (2.21% of the total population); and 5436826 (20.2%) of them have movement disability. Over 33% of persons with disabilities are in the age range of 10-29 years* (<http://mospi.nic.in>) and that involves the youth of the country. There is a need for appropriate user-friendly assistive devices that could be made available on the fly. The presentation demonstrates first attempt in India to develop fully functional load bearing transtibial prosthetic sockets and orthotics, by additive manufacturing primarily using Filament Deposition Manufacturing FDM followed by Selective laser sintering-SLS. A digital transformation route map is established with data tracking and follow-ups, where custom 3D scans are modified using open source software platforms. The modified scans are 3d printed to get the sockets post validation. A proprietary product development management software is developed and being improved to have all the inputs in one place that could even be accessed remotely. The user's body segment is scanned, which is digitally modified as per anatomical requirements, validated on the control software and then 3D printed to get highly precise products like sockets to be assembled for fitting, with minimum material wastage, machinery and skill.

The first set of functional prototypes are designed and piloting are under process. Various process parameters are experimented and multiple design iterations are done with the ultimate goal to produce a functional socket with better life and strength. To use this technology and reach out to remote location in the country and provide affordable, appropriate rehabilitation assistive device to persons with disabling condition to the lowermost strata of the community. 70% of persons with disabilities are in the rural regions of the country* (census of India 2011-<http://mospi.nic.in>). We conclude with scope of future work in terms of ISO certification of the sockets produced followed by certain open questions, which are most welcome and willing to address with the community.

The Census of India 2011, shows that there are 26.8 million persons with disabilities in the country (2.21% of the total population); and 5436826 (20.2%) of them have movement disability. As per the National Sample Survey report on disability of 2002, which the last comprehensive survey of disability in India, 8% of people with locomotor disability are amputees. Relating to the census figures of 2011, this 8% represents some 435 000 persons. Over 33% of persons with disabilities are in the age range of 10-29 years* (<http://mospi.nic.in>) and that involves the youth of the country.

The field of rehabilitation has witnessed various approaches and changes in the course of evolution of service provision. The earlier approach of use of wood and metal for socket development, until the 80's and 90's was taken over by the introduction of the resins and leather primarily. There had been very limited investment in both the government and private sector to enhance the growth and development in the rehabilitation field in these decades.

Mobility India along with conglomeration of technology partners, who are into 3D printing, digital design, material development, are making the first attempt in India to develop fully functional load bearing prosthetics sockets and orthotics, by additive manufacturing. This way we are enabling this industry to move towards automation, digital transformation and reducing man hours,

increase productivity, optimum resource management and reduce health hazards in the process. We are also demonstrating how prosthetics and orthotics can be just a desktop affair without the need to setup a shop floor, tooling and minimize overheads.

To begin the research, proprietary materials and commonly known materials, both are being used to 3D print custom patient specific transtibial sockets for below knee amputees with our own FDM printers manufactured in India under the brand 3D Prototyperz. A digital transformation route map has been established with data tracking and follow-ups, where custom 3D scans are being modified using open source software platforms.

Our invention is a remote design and manufacturing of assistive devices (Prosthetics & Orthotics) with minimum human resources and wastage, no tool room but in a desktop ecosystem with all the departments under one roof, and deliver to end users to their location. Our invention is incorporating the digital technology into assistive device design and development. The starting point being capture of the digital data through 3D scanning process of the affected body part needing assistive devices without the use of plaster of Paris bandages as in conventional method. This is followed by importing the scanned data into the open source software and doing the modification of the data and 3D models using normal anatomical and biomechanical principles on the computer screen.

Currently, this process of rectification is done manually on the plaster of Paris moulds. Using computer-based checking techniques developed specially to check all the dimensions, shapes and references as per the actual data captured, the modified 3D model is verified with the actual body measurements and this ensures exact fittings parameters are met. This verified shaped 3D model is ready for 3D printing.

The current invention is undertaken to reduce the challenges arising out of the conventional method of development and to reduce the chances of errors being made during the design and fabrication process. The chances of working remotely is possible as apart from the measurement and fittings that could be done at the doorstep of the patient all other parts could be done remotely. This invention could reduce the cost of production process and time and will need limited stock. The number of trained personnel could be reduced to one. The overhead cost could be reduced to more than half in this innovative process. The infrastructure cost could be reduced significantly as majority of the stages are done digitally. Better data base management and data analytics which will be the first step towards building Big Data helpful for machine learning.

The ultimate goal would be to find the best thermoplastic suitable for additive manufacturing, which is affordable and available locally and develop the optimized process parameters for better and stronger prosthetics.

The first set of functional prototypes are being produced and initial clinical trials are under process. Various process parameters were experimented in the study and multiple design iterations are done with the ultimate goal to produce a functional socket with better life and strength.

We conclude with scope of future work in terms of ISO certification of the sockets produced followed by certain open question, which are most welcome and willing to address with the community.

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Innovations in Different Types of Biomedical Devices

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ABSTRACT

India is currently importing about 0.65 million USD worth of different types of medical implants and devices. Most of the imported implants and devices are found to be expensive and not suitable for Indian patients because of their design limitations. Thus, it is very much essential to develop indigenous devices at an affordable cost without compromising their functional activities. Our objectives are to design and develop patient specific biomedical devices, implants and their testing devices as per ISO/ASTM standards in order to meet their individual requirements. In this direction, the products being developed by our research team are broadly kept under three different categories namely implants, biomedical devices and testing devices. Under the implant and biomedical devices, the following such as (i) ultrahigh molecular weight polyethylene based acetabular cup, (ii) 3D printed shape memory polyurethane based aneurysm coil, (iii) different types of cerium based anti-scavenging material to absorb the excess reactive oxygen species to preserve the residual hearing after cochlear implant fixation, (iv) in-situ blood pressure monitoring using cardiac implantable devices, and (v) suture medicated vascular closure device are being developed. In connection with testing devices of implants and devices, the following such as (a) hip joint wear simulator as per ISO 14242-1, (b) Orbital bearing machine wear simulator as per ISO 14242-3, (c) amputee walking simulator, and (d) gait lab are being developed. Related to prosthetic and orthotic devices and other assistive devices, (i) polymer based polycentric knee joint, (ii) dynamic foot, (iii) custom made ankle foot orthosis, (iv) direct socket fabrication system, (v) electronic weighing unit to measure the weight of the patient in the bed are being developed. One of the prosthetic devices namely polymer based polycentric knee joint was designed, developed and made patient trial for 12 trans-femoral amputees. The improved version of the device is under patient trial for ~50 amputees. Our team members have been studying and working on the requirement of devices, design, prototyping and development of functional model for its trial. Our motto is to develop different types of biomedical devices and implants which meet Indian requirements as per FDA/MCI regulations.

India is currently importing about USD 0.65 million worth of different types of medical implants and devices. Most of the imported implants and devices are found to be expensive and not suitable for Indian patients. Our objective is to design and development different products under the category of biomedical devices, implants, and their testing devices as per ISO/ASTM standards in order to meet Indian patient-specific requirements.

We are working on various medical devices. According to the WHO, medical device means any instrument, apparatus, implement, machine, appliance, implant, reagent for in vitro use, software, material or other similar or related article, intended by the manufacturer to be used, alone or in combination, for human beings, for one or more of the specific medical purpose(s) of:

- diagnosis, prevention, monitoring, treatment or alleviation of disease
- diagnosis, monitoring, treatment, alleviation of or compensation for an injury
- investigation, replacement, modification, or support of the anatomy or of a physiological process
- supporting or sustaining life
- control of conception
- disinfection of medical devices
- providing information by means of in vitro examination of specimens derived from the human body

There have been innovations made in different types of assistive devices (ADs) and biomedical devices, and we have been working on these. These include feasibility studies on UHMWE/NWCNT composites for total joint replacements (hip). It is able to reduce wear-volume and increase longevity of the product. Another project is that of preservation of residual hearing by localized delivery of nanoceria-based solid solution as an anti-oxidant in cochlear implantation. 100% loss of residual hearing over time has been reported after cochlear implantation which is hypothesized to be due to generation of excess of reactive oxygen species (ROS). Nanoceria has been proven effective in inhibiting the progression of the ROS-induced cell deaths both in-vitro and in-vivo.

We have also developed an indigenous suture-mediated closure device for closure of arterial-access site to achieve instant haemostasis following catheter angiography and interventions. We are working on a bulk bone marrow aspiration device. Bone marrow improves the bone formation for distraction osteogenesis (bone lengthening). Multiple sites are to be identified for the extraction, and low volume is extracted from each site. The objective is to extract the maximum bone marrow from a single site. The device employs a step-up screw conveyor mechanism to collect maximum material.

We have made a knee joint using nylon which has 135-degree flexibility of motion. Trans-femoral knee rotator will provide a medial-lateral rotation of the knee joint for cross-leg sitting position. It has trochanter-knee-Ankle alignment adjuster up to 10mm in the anterior-posterior direction to increase stability and voluntary control zone. The knee joint was sent for patient trials to IIT Bombay, NEIGRIHMS, 151 Army ALC Dept, Guwahati, ALC Pune and Regenesi Healthcare Services, Delhi.

We have also developed a multi-axes ankle joint:

- The range of motion of ankle joint is 30° dorsi flexion and plantar flexion, and 20° eversion and inversion.
- It is small in size and weight and can be used with SACH foot or any solid ankle Foot.
- The design of the ankle joint provides lower axis of motion similar with anatomical ankle joint axis, which provides a biomechanical advantage to mimic ankle motion.

We have developed a dynamic ankle joint.

- The ankle joint will provide adequate mechanical strength along with provision of conserving the energy with the help of a spring.
- Healthy walking pattern in an uneven terrain or sloped region will be ensured by the newly-developed product
- It can provide plantar-flexion up to 450 and dorsi-flexion up to 200 and inversion-eversion of up to 100.
- The product is developed as per the anatomical size of human ankle joint and it can be used irrespective of leg size, age, gender.
- This is a boon to total amputees as 47% of total amputees have not used any prosthetic devices due to their cost factor.
- The product will be affordable, light weight and of easy maintenance.

An ankle-foot orthotic device is into the second trials.

IIT Guwahati has developed non-invasive diagnosis and treatment for osteoarthritis (OA) using an orthotic knee brace.

- Its polycentric joint system will provide instantaneous axis of anatomical knee joint motion. The jackscrew system will provide correction force for bow leg correction.
- The shifting of ground reaction force to lateral condyles is aimed to reduce cycling loading of medial condyles in persons with medial compartment knee OA.

- It has a unilateral design for weight reduction and is cosmetically appealing. Another innovation is the design and development of rehabilitation and walking aid device for paraplegic patients. It operates on the basis of passive mechanism - transfer of forces generated from upper body movements from one leg to a reverse movement of the other leg of a user. It is a modular version of Reciprocating Gait Orthosis (RGO) developed which can be used on different patients. The main features of it are that waist and height size can be adjusted according to patient anatomy. It is topologically optimized. It is affordable. We are working on an amputee walking simulator, and in the design and fabrication of a hip joint-wear simulator for testing total hip arthroplasty.
- ISO 14242 is followed while designing the simulator which will replicate in vivo condition of hip joints.
- All three motions of the human hip joint (Flexion-Extension, Internal –External, Abduction-Adduction) will be replicated to the realistic human gait cycle with dynamic loading using servo-motors.
- Anatomical position of the acetabular cup, 210 inclined with horizontal plane, under the same loading and physiological fluid condition as per ISO 14242 is maintained.
- A bellow type closed chamber is made where the implants are immersed in the bovine serum which is maintained at 200C (in order to avoid its degradation) by an external cooling system
- Controller, servomotor and other systems were selected by considering the knee joint as per ISO 14243 and intervertebral disc joint ISO 18192.
- The system becomes a modular version to test all major load bearing joint testing.

We will have a full-fledged Gait Lab within in a couple of months.

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Universal Design

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ABSTRACT

Universal design learning includes understanding of assistive products and aids for people with sensory disabilities concerned with vision, speech, aging and Autism. Therefore, familiarity and understanding of various existing and emerging technologies of the present and the state of the art becomes essential in order to conceptualize assistive and adaptive design solutions for managing disabilities. The case studies shared in this presentation are design solutions based on the brief given below. To Creating a unified 'Command and Control' console will save both demands on mobility as well as response time, especially for the elderly or otherwise challenged. The premise being that, distributed controls in a house increase the access costs of a control by making undue demands of movement, location finding, and responsive action. While the starting point of these projects was to enable the elderly, this framework, very well applies to the entire spectrum of the population.

NID envisions this program on Universal Design to create design influencers who will bridge the gap between thought and product, between the privileged and the common. In other words, the program bases itself in human centric Universal Design (UD) thinking and approach, leading to easily adaptable and viable design directions for a wide and diverse audience.

I am a faculty in UD, a young department in NID which was started in 2015. It aims at UD thinking. We have a Master's degree program. Design always starts with the user perspective. I will present a case study here. The design brief is to create a Command and Control console which will save both demands on mobility as well as response time for the elderly or otherwise challenged. Most people in Bangalore apartments especially the ageing, live alone, and have certain issues, such as knee pain, difficulty walking and climbing stairs, cannot squat, have frequent visitors and frequent phone calls. The frustrations accompanying these problems are phone battery draining out easily, inconvenient charging point/frequent charging required, adjusting specs to read text on phone, weakness or fatigue, high blood pressure, easily tiring during exercise or activity, and switching on lights at night/midnight. We have tried to address these issues through design a solution. Opposite to our NID institute is Platinum City, a high-rise with lots of people living there.

We did a user journey mapping (daily routine), identified problems and frustrations, pain points and needs, physical and cognitive activity, what are the pain points (people at door, doing tasks), needs and insights into challenges faced. For instance, we realized we need to:

- Simplify complex input program in an appliance. (washing machine, microwave)
- Appliances which are used frequently should be accessed first
- Many appliances have similar type of control
- (need to) Design single control or button for similar functions

Then we developed a device to address all issues being faced by them in their home. We identified what devices are in which room. How one can commute without having any difficulties. Since our users are very old and have difficulty in moving, we thought of a table-top +recliner hand supportive console with less display buttons, flat display with thumb control and designed to fit on the user's chair. We have designed a console which can operate any of the devices on which they want to work. It is a wireless mobile device to operate the TV, main door lock, hall switches, geyser and so on. Our first brief was for senior citizens but it is designed for everyone. The devices (console) can help PWDs, these are accessible devices. As of now, these are all at concept level. In our dept we look at it as a PSS system: product, service system. UD is considered within our curriculum related to barrier-free built environment. This is just a small example of what work we are doing in AT.

Assistive Technologies: Idea to Invention to Innovation to Impact

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ABSTRACT

There is immense potential to solve unmet needs of the society by exploring emerging technologies, developing innovative solutions and offering them to market by licensing to startups or industry, thereby creating employment opportunities as well. Most real-life problems are multi-disciplinary in nature and require collaboration between experts with different backgrounds. In healthcare domain, the first step is unmet need identification by doctors, followed by focused research by scientists, product development by engineers and commercialization by entrepreneurs. Together, they need to traverse the 'Valleys of Death' between idea, invention, innovation and impact. Two examples of assistive technology products developed at BETiC – Biomedical Engineering & Technology (incubation) Centre of IIT Bombay are narrated here.

The first is an above-knee prosthetic leg developed and the second is knee ankle foot orthosis. Both projects involved team members with complementary skill-sets as well as experts from other organizations, including engineering institutes, hospitals, NGOs and rehabilitation centres. Both teams spent considerable time in field, observing and understanding existing products and processes to identify problems and unmet needs. Both projects leveraged 3D modelling, 3D printing, computer simulation and gait analysis to develop the prostheses in a scientific manner. In both cases, the resulting product had better form, fit and function compared to conventional devices (Jaipur Leg and drop-lock callipers). This is expected to provide improved walking gait along with reduced energy consumption. Yet, the fabrication time, technical skill level and total cost are expected to be similar those for conventional low-cost prostheses. Both projects exemplify the 'bedside to bench to business to bedside' philosophy evolved at BETiC for rapid translation of research work into marketable products with high potential for social impact.

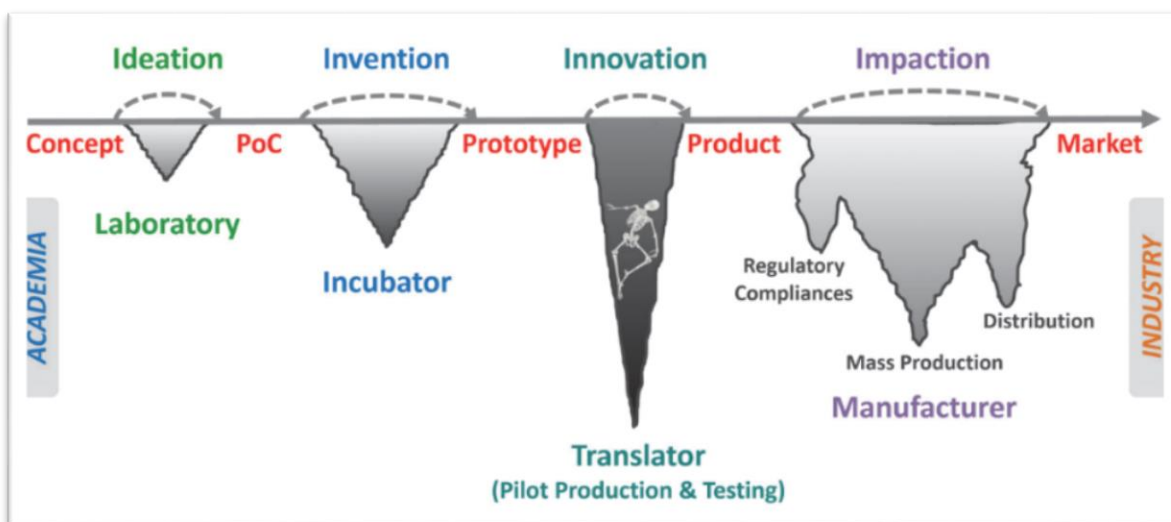
Introduction

There are over 14,000 healthcare problems faced by humankind, as per World Health Organization. Safe and effective devices are required to screen, diagnose, monitor, operate, treat and rehabilitate the patients. The Indian medical device market is currently valued at Rs. 48,500 crore per year of which 80% (INR 39,000 crores) are imported, mostly from USA and Europe. The healthcare expenditure in India is 5% of GDP; in per capita terms it is less than 1% of that in USA. Clearly, there is a need to develop affordable yet high-quality devices suitable for the location population. This requires a suitable eco-system for indigenous medical device innovation and commercialization. The market need exists - clinicians continue to ask for better and safer devices, which are easy to adapt and use. On the other hand, there is a basket of new technologies that provide an opportunity to rethink and reengineer novel products. This requires connecting experts from many disciplines including medicine, design, materials, mechanical, electronics and software.

Most scientists and faculty focus on research and publications; some of them go as far as creating a proof-of-concept and patenting the invention. While a proof-of-concept can be fabricated at less than Rs. 50,000 in the laboratory, it may require over Rs. 50 million for mass production and initial marketing. There is a valley of death from research prototype to marketable product, which academia and industry are incapable or unwilling to cross.

BETiC– Biomedical Engineering & Technology incubation Centre was established in 2014 at IIT Bombay to connect doctors, researchers, entrepreneurs and investors for medical device innovation. The initiative is supported by RG S&T Commission, Mumbai, and DST, New Delhi. Two satellite centers were set up at COE Pune and VNIT Nagpur, who are partnering with four other engineering colleges (KJSCE Mumbai, MIT-ADT Pune, SIU Pune, and GHRCE Nagpur) and seven medical institutes (HITRT Mumbai, JJMC & GDCH Mumbai, MGMIHS Sanpada, BJMC Pune, DMIMS Wardha and BKLWRH Dervan), making it the largest such network in the country.

The bedside-bench-business-bedside model evolved at BETiC helps traversing the ‘valleys of death’ between ideation, invention, innovation and impaction. The model includes four phases: defining an unmet clinical need, developing a novel solution, delivering a tested device, and deploying it in clinical practice. In the last 5 years, BETiC team members gathered over 400 unmet clinical needs from different hospitals, developed proof-of-concepts of 200 different medical devices in close collaboration with expert doctors, and filed 55 patents. Of these, 25 products have been developed, which include screening & diagnostic devices; surgical instruments; implants, prostheses and assistive devices. Team members incubated 15 start- up companies and licensed 5 products to industry.



Valleys of death in product lifecycle



Medical device innovation phases and steps

The innovation process evolved at BETiC is described in 'The Essence of Medical Device Innovation' book (Crossword, Mumbai). The Medical Devices Quality Management System of BETiC received the ISO 13485 certification. This eases the path for government regulatory approvals for medical devices developed by the innovators.

Assistive devices developed at BETiC include an above-knee prosthetic leg and knee ankle foot orthosis. These are briefly described here.

Above-Knee Prosthetic Leg

Over 5 million Indians have lost a leg or its portion, as a result of congenital condition, tumour, trauma or some illness like diabetes. An assistive device in the form of crutches or leg prostheses is required for standing and locomotion. Leg prostheses are classified as Above Knee (Trans-Femoral) or Below Knee (Trans-Tibial). Above-knee prostheses comprise socket, knee joint, shank/pylon and foot.

Several NGOs, such as Ratna Nidhi Charitable Trust, Mumbai fabricate prosthetic legs based on the original concept and process developed at BMVSS, Jaipur and provided them free of cost to amputees. To cater to rural patients (who find it difficult and expensive to come to Mumbai), the NGO technicians organise camps in remote areas and create replicas of residual stumps of amputees using plaster. Then HDPE pipes are heated and pushed over the POP stump to create a matching socket. This is integrated with a shank and Jaipur foot. The prosthesis is then delivered to the amputee for fitment, alignment and training. This process is cumbersome and error-prone, requires skilled technicians, uncomfortable to the amputees and requires transport of technicians and raw materials to remote areas. Further, the conventional Jaipur leg has a lockable knee joint (unlocked during sitting), leading to poor walking gait, balance and efficiency.

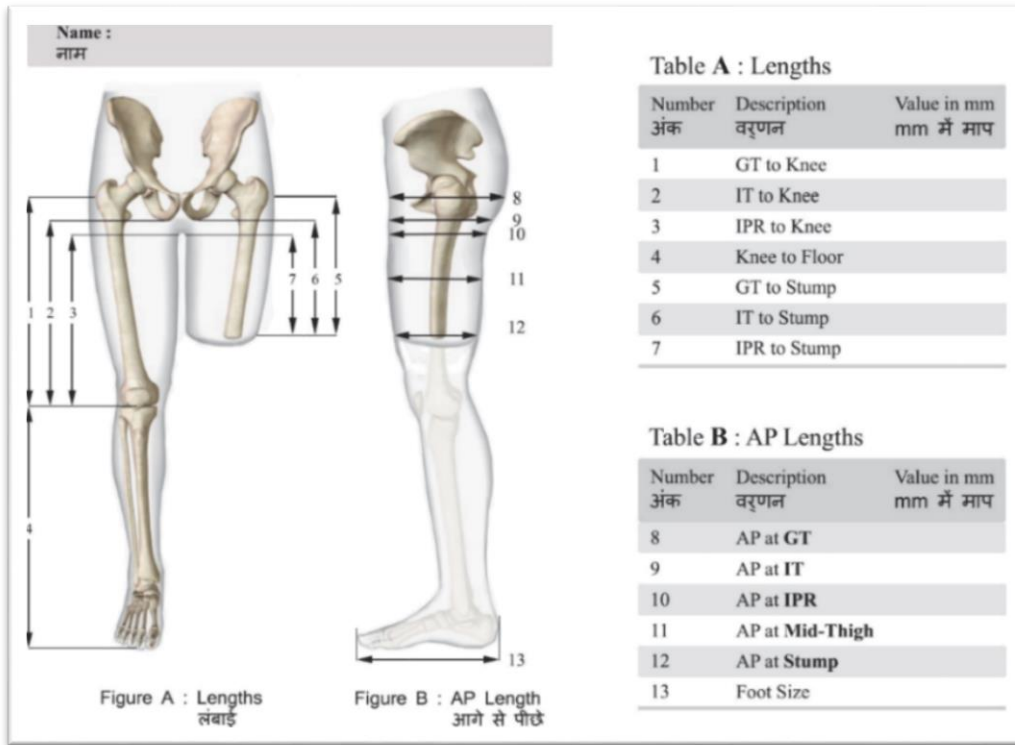
The BETiC team took up the challenge to “develop an improved trans-femoral leg prosthesis along with efficient fabrication process”. They first explored hand-held 3D scanner to capture the geometry of amputee’s stump. The scanned images were used to generate a 3D CAD model, which was 3D printed to obtain a replica of the stump. The prosthesis socket was then fabricated using the conventional method of heating a HDPE pipe and pushing it over the stump model. It was however, found that the scan data was difficult to transmit over poor bandwidth in small towns.

Hence the team developed a parametric CAD model, which could be fed with 12 measurements taken on patient’s residual limb as well as intact limb and sent through sms to the fabrication center. Based on these measurements, 3D CAD model of patient’s stump can be generated. This could be used to create a CAD model of the socket. Then either the stump or the socket can be fabricated by 3D printing. The BETiC team also got in touch with Prof. Sujatha Srinivasan at IIT Madras, who provided several samples of their polycentric knee joints suitable for prosthetic legs. A suitable connector was developed.

Since 3D printing was taking a lot of time (6-8 hours, comparable to conventional plaster process), there was a need to explore an alternative route to reduce the lead time to less than half (3-4 hours), so that it could be prepared and fitted to an amputee within a working day. The team explored CNC milling of hard polyurethane foam stumps on a CNC router. The stumps were then coated with resin (for smooth finish), followed by socket fabrication by pushing heated HDPE pipe on the PU stump.

The BETiC team in consultation with the hospital and NGO evolved the detailed plan of fabricating a batch of prosthetic legs for supply to many more people. A bi-lingual chart for taking the measurements by field workers was also developed. Five more beneficiaries were selected. Their residual stump measurements were taken, and used to generate CAD models of stumps,

followed by PU foam milling of respective stumps and fabrication of sockets. These were connected to knee joints provided by IITM and Jaipur Foot provided by BMVSS to create the full prosthetic leg. The gait analysis is underway.



Bilingual chart for measurements of residual limb



Machined PU stump; resin coat; HDPE socket; prosthesis with knee joint



Gait studies on volunteer patient at MGM CHMS

Knee Ankle Foot Orthosis

Over 13 million in India people suffer from various locomotor disabilities. A large number of them develop muscular weakness of the lower limb due to poliomyelitis, post-polio syndrome, CVA, CP, SCI and MS. They require knee-ankle-foot orthosis (KAFO) or orthotic callipers. Drop-lock callipers are distributed by rehabilitation centres of government hospitals and NGO to needy patients. They lock the knee joint in a fully extended position during both stance and swing phases, to provide stability during walking. This results in exhaustion, limited mobility and pain. Hence many patients stop using the callipers.

Dynamic KAFO provides a better solution, since it is automatically controlled by the walking stance of the user. But these are bulky, do not exert a pull on the thighs to straighten the leg, cannot lock at any desired angle; and cannot be used for squatting and cross-legged sitting. Electronically controlled KAFO can automatically lock and unlock the knee joint while walking, but are extremely expensive to purchase and difficult to maintain.

The project was defined as “Low-cost mechanically activated stance controlled knee ankle foot orthosis.” The BETiC team started evolving alternate ideas to improve the design to achieve the desired functionality along with high efficiency and compactness. They modelled the designs on CAD and simulated the stresses, and optimized the section thickness to prevent failures.

Four successive prototypes were developed and fabricated. The first version was crude and manufactured by leveraging locally available resources and components. The second version had smaller and less bulky components, fabricated using water jet machining, but created components tapered at the edges. The third version was more functional and visually appealing. The number of components were reduced (to improve cost and reliability) by actuating both moving parts with the same link. Version 4 was an attempt to make the design further compact. The knee components were laser cut with precision and the holes provided at various angles gave the freedom of adjusting the component according to patients’ measurements. Several volunteer patients have been identified and gait analysis are planned.



Successive prototypes of mechanically actuated stance controlled KAFO

Conclusion

Two assistive devices developed at BETiC, IIT Bombay have been described. The above- knee prosthetic leg project involved collaboration between IIT Bombay (socket design and fabrication process), IIT Madras (polycentric knee joint), MGM Institute of Health Science Sciences (for clinical inputs and gait analysis), and Ratna Nidhi Charitable Trust (NGO for need identification and technology validation). The knee ankle foot orthosis also involved similar partners' different activities. Both projects took about two years from need identification to functional product development suitable for field trials. This clearly proves the critical role of clinicians, researchers, innovators and end-users for medical device innovation.

Acknowledgements

The BETiC project is funded by RG S&T Commission, Maharashtra, Mumbai and DST, New Delhi. The prosthetic leg project involved Dr. Triambak, Dr. Sameer Desai, Lalit Amrutsagar and Gaurav Parit. The KAFO project was taken up by Aneesh Karma, supported by Sachin Avhad. Dr. Rupesh Ghyar guided both projects at BETiC. The assistance of Ratna Nidhi Charitable Trust, Mumbai headed by Mr. Rajiv Mehta is acknowledged for connecting with the patients and for providing many valuable insights about the requirements of prosthetic leg as well as calipers. Dr. Rajani Mullerpatan, Director, Centre of Human Movement Science, MGM HIS, Navi Mumbai provided clinical feedback and access to gait lab. Dr. Sujatha Srinivasan, R2D2 Lab, IIT Madras supplied the polycentric knee joint for the prosthetic leg. Several other prosthetists and orthotists, as well as other team members at BETiC assisted in different ways.

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AT – Make in India

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ABSTRACT

Why aren't there more innovations in assistive technologies from India? One hears of many AT solutions developed by individuals, but few are translated to products and marketed. Ideas have to be translated to prototypes and then products in order to make an impact. The market for assistive technologies, if restricted to products for people with disability, is fragmented, difficult to reach and in many cases, unable to pay. With disability, people lose earning potential and independence. Many are unemployed and cannot afford even the basic devices needed. Low cost obsolete technology may be rejected easily because of lack of functionality. On the other hand, even if one can afford exorbitantly priced imported products, they may not always work effectively because of lifestyle and environment. The cost of research and development of quality products for a market that has limited purchasing power is a significant hurdle, leading to lack of interest from private industry. There is a need for functional and affordable solutions for local needs to improve employability and quality of life of people with disability. Not only appropriate research and development, but also a viable business model is required in a situation where the buyer cannot bear the cost of development. This talk will present some of the challenges and opportunities for assistive technologies to be Designed and Made in India. The speaker will share experiences and present examples of the TTK Center for Rehabilitation Research and Device Development (R2D2) at IIT Madras, which uses a model involving academia, government / private funding, industry and users to develop functional and affordable assistive devices that are designed for and made in India.

I will talk on Develop AT and Make in India. Happy birthday to MI! The need for AT has been articulated many, many, times. Even in locomotor disability the numbers are huge and they will need orthoses, prostheses, wheelchairs. I will talk of my experience in developing these devices in India. At one end you have very low cost, but primitive and easily rejected (mostly donated) devices, as they are not very functional. On the other hand, you have imported products, but not found useful for our environment and lifestyles. There is a huge space in between where we can have more functional devices, but we have to make it affordable which is the challenge. So, there is a huge market for appropriate designs.

We can explore the market for UD (universal design). The (my) problem of being one of the last speakers is that everybody has talked about everything!! India produces the largest number of engineers in the world and we have passionate and committed students. How do we go about getting simple solutions which can make a major impact? Funding is not a problem – this was a surprise to me when I started working as an academic. Now companies have to give a portion of their profits to society, CSR funding is a natural fit, and the government also gives. Development of AT is one such cause people would be happy to support.

The eco-system is also underdeveloped, but developing it has scope. Start-ups can come up in specific areas. Products such as drop-lock for KAFO, have a simple design but no development, despite the fact that there are over 1 crore users in the country. We came up with a lever-operated knee-joint for the drop-lock. It was not a problem up to the prototype level. Many devices are simple devices or need simple modifications to suit Indian needs. But why aren't more innovations becoming products? You see these on WhatsApp, then you don't see the device on the market, so the benefit of such potential devices is lost to people.

There is great need in India, but low purchasing power is a problem. Those who lose ability lose also their purchasing power. The disability market is predominantly a charity market - through NGOs and government welfare schemes, so again cost comes into the picture. Most importantly, users do not demand (quality) because it is given to them and put aside. There is no feedback mechanism from users as to how it could be improved. We actually require not just innovations/prototypes, but we need an overall viable model because in this case, no buyer – neither individual nor organization – is willing to bear the cost of development. So that is why not many industries want to come into this space. Who is going to bear the cost of product development?

One of the models we have is the GRID model: Grant (government, private & foundations), Research (use of AT to create need-based functional designs by working with researchers, hospitals, rehab centres), Industry (partner with established manufacturing capability/ expertise, and Dissemination (partner to reach out to users for extensive trials and create a market for the product). The TTK Centre for R2D2 works on this model. We have facilities for all the stages: the scientific R&D connects with industry and the user base (including an active partner in Mobility India), human resources...and bring all these together to develop ATs and launch start-ups from this. Always our focus is trying to get it to the market.

I will share a couple of instances of products near the market. One such is a wheelchair which enables the user to go from sitting to standing without help. The latest version is a 3-wheel design. As long as your base of support falls within the centre of gravity, you are stable. We have done trials with 150 users across the country. This WC is not intended for moving while in the standing position.

Wellcome Trust helped us develop it. We have gone through several iterations and tests. The US model costs several thousand dollars to import, but our product will sell for 15,000 rupees only, thanks to use of the GRID model. Wellcome Trust covered the complete R&D cost for the standing wheelchair. The NeoMotion wheelchair (through a combination of govt and private funding) is a manual outdoor WC which is a combination of scooter-wheelchair, which can detach from the vehicle when you stop.

Production volumes in AT are low, therefore, vendors lack interest in us. Tooling knowhow is required if you want quality. There is a fragmented user base. Here, our user testing partners are a huge help. NGOs don't want to deal with reimbursement schemes (as with government funding) because they don't get the money on time from the government. We need flexibility in funding, and regulatory issues are a challenge. MI is a partner on IITM polycentric knee (IIPK) where 20 users have been fitted over a year ago. Who do we give it to for production? That is the challenge.

Information and Communication Assistive Technology & Make in India

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ABSTRACT

The World Health Organization (WHO) says that about 15% of the planet's population has one or the other form of disability. This pegs the number at 1 billion and with an increase in life expectancy, newer non-communicable disease and aging population the number is expected to rise to 2 billion by 2050. If we extrapolate this statistic for India, it will translate to about 200 million disabled individuals. Stand alone, this will be the eighth most populated country in the world. Even with most conservative numbers, India will have at least 30 million people with disabilities, a number higher than total population of 75% of our planet's nations.

Despite the Constitution of India providing every citizen the right to equality and live with dignity, there are barriers which restricts their participation in every aspect of life including in education, employment, social & recreation. Barriers, according to World Health Organizations, are factors in a person's environment that, through their absence or presence, limit functioning and create disability. There are multiple barriers that makes it extremely difficult or even impossible for people with disabilities to function. Some of the most common barriers include attitudinal barriers, physical barriers, information barrier, communication barriers, policy barriers etc. Of course, these don't exist in siloes. Often, more than one barrier occurs at a time.

Assistive technology (AT), including mainstream technologies, has revolutionized the world and is continuing to do so at a faster pace than ever before. It is changing the way we communicate, study, work, shop, pay bills, entertain ourselves, socialize, gather information and so on. Some of the biggest beneficiaries of these technological developments have been people with disabilities. It has enabled a high degree of independence and promoted greater participation in social and business activities. It has opened several prospects in education and employment which didn't exist before.

The WHO estimates that only 10% of those who need assistive products in the world get access to them and in low income countries like in India the number could be as low as 5%. While, the demand is huge, the supply side issues including policy support, manufacturing scale, affordability, go to market, etc have restricted the development of assistive technology in India. In addition, The Rights of Persons with Disabilities (RPWD) Act, 2016, mandates non-discrimination and equal opportunities for people with disabilities. Access to technology has been duly recognised in the Act. In fact, access to ICT is fundamental to achieve the various mandates of the Act, be it education, employment, social security, justice or any other right. This presentation will examine the issue of access to ICT for people with disabilities in India. It looks at the role of ICT in the lives of people with disabilities, the policy framework that exists, the current status with respect to inclusivity of government and private initiatives and provides some specific recommendations that can be adopted by various stakeholders for promoting accessible and inclusive ICT in the country.

So, a very good afternoon to everybody. Thanks for the lovely introduction. I will talk about Make in India and AT from an overall disability sector and policy perspective. I want to step back and see how the understanding of disability has evolved over a period of time.

Till the 1980s and 1990s, it was considered a medical phenomenon, inability to perform usual actions was considered disability. "In the context of health experience, a disability is any restriction or lack of ability (resulting from an impairment) to perform an activity in the manner or within the

range considered normal for a human being.” The focus was on the individual disabled person - eye camps, charity, stay at home, etc.- not on the environment. In the latest understanding on disability, the social model, we have come a really long way.

“Disability is not just a health problem. It is a complex phenomenon, reflecting the interaction between features of a person’s body and features of the society in which he or she lives.”

Disabilities relate to vision, hearing, speech, locomotor, intellectual, learning, age-related, blood-related and multiple disabilities. Of the disabled, 80% are below the poverty line, 55% are literates, 13% have completed secondary education and a bare 5% are graduate or above. 36% of the disabled are workers. Today disability is not about medical conditions, but about the barriers that exist in the environment. Today I can operate like anyone else if I have the infrastructure and an enabling environment that put me on par with others. The focus changes here from charity-oriented approach to the barriers in the environment – attitudinal, infrastructure, policy-related, communication-related and so on. With this, the focus in interventions is on addressing these barriers. So, we talk about accessible infrastructure, an enabling environment. We talk about people first and disability later.

Some 15% of world’s population has a disability, 200 million in India counter a form of disability every day. Of them, 80% live in extreme poverty. A large underserved group. Technology has proven to help the disabled live an independent and productive life. And yet, only 1 in 10 have access globally, 1 in 20 have access in economies such as India. In India, 190 million disabled people have no access. Potentially, tech solutions for the disabled in India would have a DAU (daily access user) base greater than what Snapchat has globally.

Why the divide? The reasons are lack of awareness, availability, affordability, accessibility and market forces. Persons with disability are not aware of possible solutions that can help them. E.g. Screen reader. Many of the products available are often not available in India. Many of these products are prohibitively expensive. Many products and services, including websites and digital services don’t follow the standards on accessibility that makes them accessible/ usable/ inclusive of persons with disability (PWDs).

There are various information and communication technologies (ICT) available today. Mainstream technologies that exist today are computers, smartphones, operating systems, websites, mobile phone applications and kiosks. ATs include screen readers, braille displays, augmentative communication devices and one-hand keyboards. The global disabled and elderly AT market was valued at approximately USD 18.70 billion in 2017 and is expected to generate revenue of around USD 30.82 billion by end of 2024, growing at a compound annual growth rate (CAGR) of around 7.40% between 2018 and 2024. AT market is expected to grow to 30 billion in 2034.

Advances in AI, robotics and other smart technologies is resulting in a convergence of mainstream and assistive technologies, e.g. home automation, smart speakers, smart TV and self-driving cars – have resulted in convergence of AT. I myself, thanks to smart TV, am able to access the TV on my own. In the past, devices such as typewriter were inspired from the Braille typewriter, word prediction came from helping PWDs type better, Google Assistant, Alexa have genesis with assistive products. The lines are blurring, and it is getting better.

The challenges in India’s AT and ICT are:

- The lack of enforceable policies and will
- Limited awareness of AT/ICT potential
- Unaffordability of AT/ICT
- No encouragement for Make in India

- Limited resources to support long-term research
- Unavailability of products especially in rural areas
- Inaccessibility of products, platforms & content
- Lack of acquaintance on how to use
- Absence of eco-system awareness
- No scientific assessment criteria.

The eco-system that funds these projects, that test these projects, is missing and PWDs themselves don't come out because of the stigma. What come out are poor quality products that are not tested. E.g. the cochlear implant scheme requires a rehabilitation therapy, and follow-up, which are not provided. For rural children, the surgery is meaningless without rehabilitation therapy which is available only in urban centres, and so, is not accessible.

The RPWD Act provides a strong legislative framework. It:

- Provides a wider definition of communication
- Recommends standards for technology accessibility
- Provides a two-year timeline (June 2019) to make all services accessible (but this has not happened)
- Promotes universal design in electronic goods (but these have not happened)
- Encourages accessible information on TV - starting 2009 with web accessibility policy to 2018 with Revised Guidelines for Indian Government Apps and websites (GIGAW).

International procurement best practices say you can't do business with the government if you are not accessible. DePWD announced that 100+ websites have been made accessible. However, there is no impetus to AT in key initiatives such as Make in India, Startup India, Smart Cities and Digital India. Lack of scientific methodology and poor quality leads to high rate of abandonment. And the Assistance to Disabled Persons (ADIP) list doesn't keep pace with changing technology. The Artificial Limbs Manufacturing Corporation of India (ALIMCO) has improved access, but quality is a big challenge.

With regard to the private sector, industry bodies such as Federation of Indian Chambers of Commerce & Industry (FICCI) and National Association of Software and Services Companies (NASSCOM) are building awareness and new AI based solutions such as Seeing AI, Soundscape, Eye-D. But there is no sense of urgency to make products and services accessible. There is limited enthusiasm from the Private Equity/Venture Capital community to fund AT/Accessible ICT ventures. Corporate CSR is not prioritizing A11Y – extensions which empower all users of a computer system, including those with disabilities or impairments.

The barriers that exist in society for PWDs are real. They:

- Cannot read because books are not in accessible formats (e-text)
- Cannot travel because there is no accessible transport
- Cannot communicate because there are no sign language interpreters
- Cannot work because employers have negative attitude and/or there is lack of support systems

The implication is that the person is at the centre of the problem: Cannot read because he/she is blind, cannot travel as he/she cannot walk, cannot communicate as he/she is deaf, cannot work as he/she is mentally retarded.

The highlights of civil society and A11Y NGOs and start-ups is that academic of IIT Delhi, Bangalore and Madras are involved in it. The eco-system has been widened by involving Samarthanam Trust, Social Alpha and others. Next generation NGOs such as Friends for Inclusion, Blea Blea TV, Vision Empower are getting involved. The lowlights are lack of resources

and expertise, lack of consistent advocacy with stakeholders, limited exposure and capacity to assess and adapt latest technology, fragmented and no consolidated effort.

I see the way forward in the following manner:

- Constitute an Access Board/ Commission/ Regulator that acts as an advisory and regulator for all things on accessibility and assistive products.
- Setup a disability unit in all ministries to ensure all schemes & initiatives are inclusive of persons with disabilities & aligned to the spirit of the RPWD Act; and ensure that all digital initiatives such as portals, websites & procurement are accessible to people with disabilities.
- Adopt & enforce Standards for Public Procurement that mandates accessibility features in procurement of all ICT product & services. Refer: European Standards for Public Procurement EN 301 549.
- Strengthen implementation & enforcement of RPWD Act & ensure all stakeholders comply to standards & timelines around accessibility.
- Fastrack the establishment of a Universal Design Institute that will promote, research & build capacity of stakeholders on standards to make a range of products & services accessible.
- Revamp the ADIP scheme that assists people to procure essential assistive technologies. The revised scheme should have a scientific method to assess the AT needs based on functionality, that supports all disabilities recognized in RPWD Act, doesn't have an income ceiling and that keeps pace with the latest technology developments.
- Provide financial incentives to original equipment manufacturers (OEM), start-ups & other stakeholders to research, develop & commercialize products & services that cater to the need of persons with disabilities.

What is heartening are the following examples of AT in use:

- 3d printed tactile educational materials are being used to teach students with visual disabilities.
- Watch & learn videos with captions are being used by deaf people, people with autism, learning disabilities & other disabilities to gain knowledge & skills.
- TTS, STT, spell check & word prediction software are of tremendous use to people with dyslexia.
- Ipad applications are helping people with autism in organizing, scheduling & social interactions, leading to independence & employment.
- FM systems are enabling students using hearing aids to hear only the trainer's voice in a training session.
- Accessible controls for computers and gaming consoles are being used by people with difficulty using the mouse to play games.
- Braille displays and Braille writers are being used by people with deaf blindness to work and communicate.
- Live transcription using Google docs is being used in a college of people with hearing disability.
- There is a huge untapped potential out there for e.g. a wider talent pool in Wipro. There are new market segments to be tapped e.g. Skype and Uber; and new product offerings such as the SmartCane.

A Guideline for Service and Delivery to Ensure Quality of Life of Elderly People

Datta T.K., former HOD, National Institute for Locomotor Disabilities, Kolkata (WB), India and Member, Indian Association of Assistive Technologists
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ABSTRACT

Assistive technology, when used appropriately has the potential to support people with disabilities mainly to the older people. An appropriate and effective Assistive Technology service could provide a significant return to the community as a whole. Populations in India are rapidly changing on older people and need a proper policy on right based approach. It's observed that maximum number of different professional need support for the older people rehabilitation. According to Population Census 2011 there are nearly 104 million elderly persons (aged 60 years or above) in India; 53 million females and 51 million males.

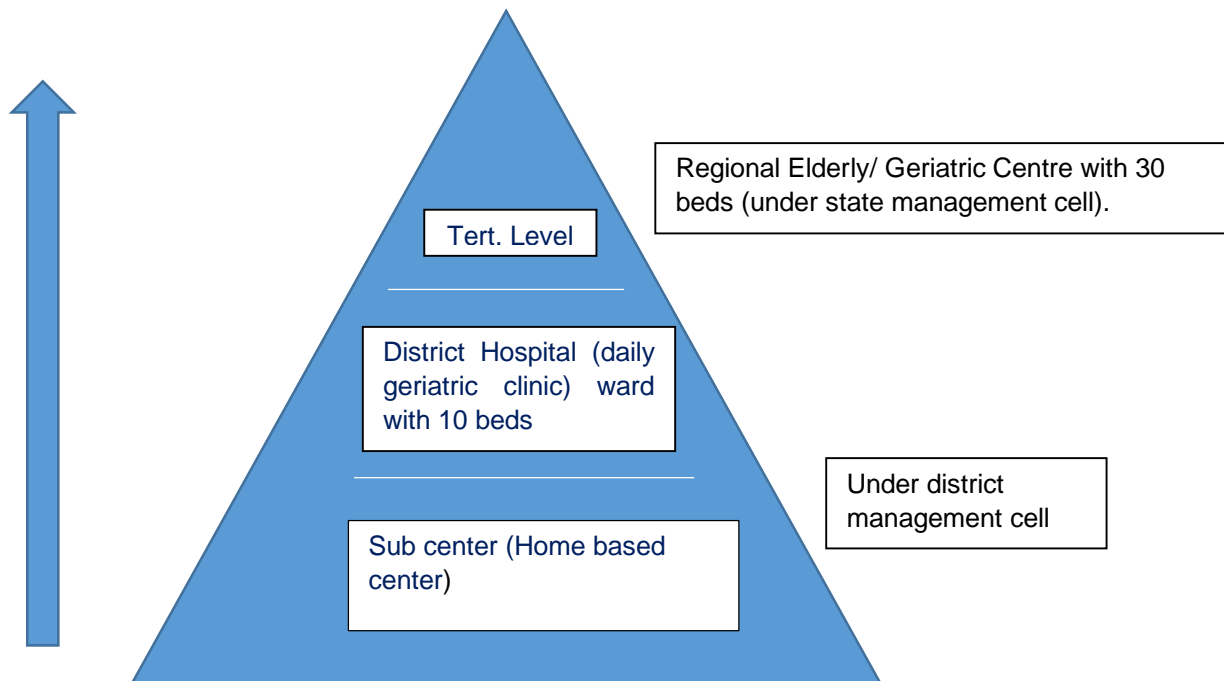
The purpose of this evidence based statistical analysis tried to bring many aspect unveil like older pupil now, their needs and how to embrace the changing needs of time focusing 2050 with a clear policy.

Methodology consists of calculation and analysis of many different statistical reports already established on elderly pupil in India and their right. The analysis is done on Census, NSSO, election 28 April 2019- ABP and many more. Study done on the basis of state wise fund release from MSJ&E (DD) with extensive review of different Act in India on older people. State-wise data on elderly population divulge that Kerala has maximum proportion of elderly people in its population (12.6 per cent) followed by Goa (11.2 per cent) and Tamil Nadu (10.4 per cent) as per Population Census 2011. Some of the states, it is 4-5 percent.

The result shows a very important aspect, that some of the areas the older people are the deciding factor in the election it has also seen that allocation of government funds (MSJ&E) in the rehabilitation of elderly people are not as per the population and a gross state wise disparity. The vote-based politics silent on Elderly people because of not united and the voice are not raised. The 60+ population will be 32.8 Cr. in 2050 in India. There are about 3000 organizations (Government and voluntary) in the Indian disability sector providing rehabilitation services to persons with disability. 10% of population is in special need category. 1) Maintaining of electronic health record on older age with population stabilization. 2) Mid-level service provider/ Paramedics skill course to start appropriate course/ bridge course to cater service.3) Financing health care. 4) Initiate roll of civil society with the coordination of all service provider.

In conclusion we have to formulate a policy considering the present needs with their basic needs and looking farsighted vision on 2050. A comprehensive social security system with free health care. To coordinate the different organizations for jointly formulate the policy and vision which is very important in democratic nation like India.

- Sub Centre will play a very important role.
- Health Education related to healthy ageing (Designing geriatric training courses for health workers who can assist in home-based care of disabled older people).
- Domiciliary visits for attention and care to home bound / bedridden elderly persons and provide training to the family care providers in looking after the disabled elderly persons.
- Arrange for suitable AT equipment's and supportive devices from the PHC to the elderly disabled persons to make them ambulatory with AT personnel.
- Linkage with other support groups and day care centres etc. operational in the area.



The old-age dependency ratio climbed from 10.9% in 1961 to 14.2% in 2011 for India as a whole. For females and males, the value of the ratio was 14.9% and 13.6% in 2011. Maintenance of Parents/ senior citizens by children/ relatives made obligatory and justiciable. Revocation of transfer of property by senior citizens in case of negligence by relatives. Penal provision for abandonment of senior citizens. Establishment of Old Age Homes for Indigent Senior Citizens with provision of AT service. Protection of life and property of senior citizens. Adequate medical facilities for Senior Citizens with combined AT service and provision. It is seen that:

85% elderly suffer from muscular & skeletal disease
 35% have respiratory problems
 78% have digestive problems
 40% have chronic cough & cold
 85% have some skin disease
 23% have raised blood pressure/heart trouble
 13% have raised blood sugar and
 2.5% have insomnia, dementia, senility & other ailments.
 Most of them have B2, B6, C, D, and Calcium and Iron deficiencies.

It has been also observed that use of technology in old age requires determinants and motivating factors for implementation of any guideline and monitoring. So, the provision has to prepare on information and communication technology (ICT) and development of software.

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User-Centred Approach in Creating Impactful Solutions for the Disabled

Mr. Trivikram Annamalai, Indian Institute of Technology (IIT), Mumbai, India and Senior Designer, Atlassian, Bengaluru, India
Email: trivikramidc@gmail.com Phone: +91-9833513807

ABSTRACT

The paper presents an imperative framework that places the 'user' in the center of focus for innovations in the disability sector. The paper talks about using 'enhanced UCD canvas for healthcare' which helps in understanding the core user needs and develop feasible solutions with unique value proposition.

In conjunction with UCD canvas, insights based on research of understanding the psychology of users - their fears, needs and hopes are presented in this paper which further help improve the efficacy of the solution. The methods and framework which help translating ideas from drawing board to tangible products that are sold in the market are narrated using a case study - 'Research and design of Low cost vein detector device', where an end to end design process is presented starting from research methods involved in performing user survey, deriving impactful insights from field research, ideation tools, prototyping methods, collecting user feedback and refining the solutions based on the feedback.

Keywords: Design thinking, unique value proposition, prototyping

I. Introduction

The Problem

Many healthcare related issues, like the ones mentioned in the Priority list by WHO [4] need innovative solutions that are affordable and reach the needy people. But how does one go about finding solutions to these problems? How can a trained healthcare professional become an innovator? The solution that is presented in this paper is a canvas methodology derived from UCDC [1], the modified canvas is tailored according to the needs of the disability sector.

Design Thinking

A process which keeps user at the core and solutions are built around the user based on their specific needs and problems. Design thinking as defined by Interaction Design Foundation [2] 'we seek to understand the user, challenge assumptions and redefine problems in an attempt to identify alternative strategies and solutions that might not be instantly apparent with our initial level of understanding. At the same time, Design Thinking provides a solution-based approach to solving problems...'

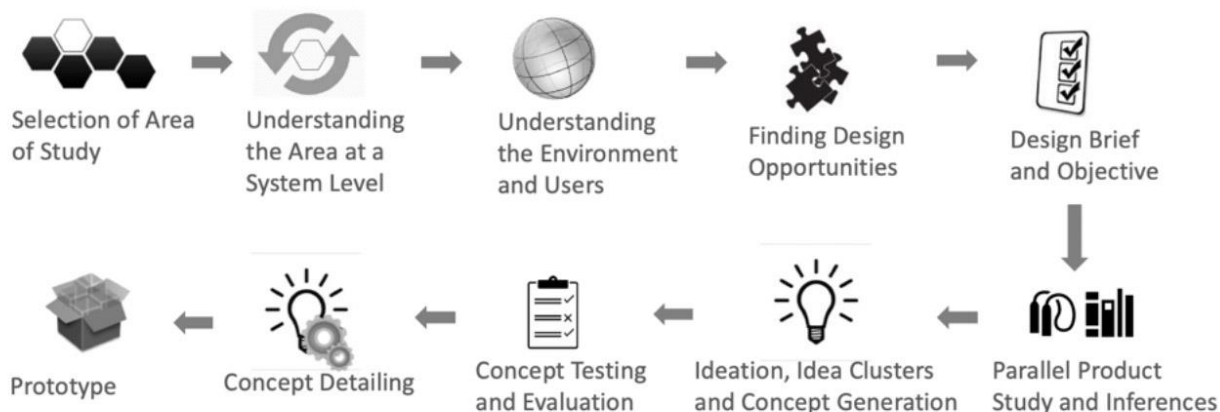


Figure 1. Design process for innovation in healthcare. Source: Author

II. Method

The objective of using the modified UCDC canvas method is to have a holistic approach in solving a healthcare problem, the framework demonstrated below shows key parameters that needs to be covered to have a solution which does not miss out on any integral parameter.

Problem	Research	Users	Unique Value Proposition	Ideas	Deliver
<ul style="list-style-type: none"> Define the need 	<ul style="list-style-type: none"> Primary Research 	<ul style="list-style-type: none"> Understand the user Fears 	<ul style="list-style-type: none"> Business Considerations 	<ul style="list-style-type: none"> Generate multiple options 	<ul style="list-style-type: none"> Build prototype Test with real users
<ul style="list-style-type: none"> Empathize with user problems 	<ul style="list-style-type: none"> Secondary Research 	<ul style="list-style-type: none"> Needs 	<ul style="list-style-type: none"> Competitive Advantage 	<ul style="list-style-type: none"> Refine and select concepts 	<ul style="list-style-type: none"> Manufacture and follow up
<ul style="list-style-type: none"> Immerse yourself and relate to user's life 		<ul style="list-style-type: none"> Hopes 			

Figure 2. Modified UCDC canvas. Source: Author

Each of the vertical mentioned in the canvas necessarily needs to be covered from left to right, where in each of the sub-components are important touch points which needs to be done by the innovator in order to come up with a comprehensive solution.

2. Details of Subsections

Problem: In this section the innovator needs to empathize with the daily life of the user, to understand their needs and problems that needs to be solved.

Research: This section has 2 sub-parts, a. primary research, involves field research and survey, interviews using well composed questionnaires. b. secondary research, involves desk research using relevant books and online information.

Users: Possible anxieties of user needs to be captured, also being sensitive of what the user's hopes and goals are.

Unique value proposition: The purpose of the activity is because the existing solutions have flaws, hence the approach the innovator needs to take towards formulating the new solution/s is by starting with the question as to what is different and novel that is not present in the other products in the market -this is termed as competitive advantage. Understanding the trends in market and business viability are the other considerations in this column.

Ideas: A top down approach of starting from an open and un-biased thinking where creativity and quantity are the primary focus, once there are many idea options- depending on the feasibility and relevance, the best ideas are chosen and end-to-end concepts are built.

Deliver: The chosen concept will be prototyped with the most relevant tool - digital or tangible. The prototype is then tested on the users to get the initial impressions and feedback, with every user testing -iterative ideations are done to refine and improve the solution before they are manufactured.

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5. [4] Priority Assistive Products List (APL), World Health Organisation, Assistive health technology, www.who.int/phi/implementation/assistive_technology/global_survey-apl/en/

Annex-1 Programme Schedule of the Conference

National Conference on Assistive Technology for ALL -2030 (2-3 Aug. 2019)			
Programme Schedule			
DAY 1, Friday 2nd August 2019			
Presentation		Speaker/Presenter	Chair/Co-chair/Moderator
09.30	Global Cooperation on Assistive Technology (GATE) and its relevance to India	Dr. Patanjali Dev Nayar, Consultant-Noncommunicable Diseases and Environmental Health (NDE)-WHO SEARO	Chair: Dr. Shyam Vasudeva Rao Managing Director-Forus Health Pvt Ltd., Director- MYMO wireless, Co-founder & Director- RenalyX health systems, eHealth enablers and Rx Digi Health Platform, Bangalore
10.10	WHO perspective-Need, demand and supply of Assistive Technology (AT) in India	Dr. Gaurav Gupta National Professional Officer (Injury & Disability Prevention), WHO-India	
10.30	Perspective from MSJ&E on AT provision in India	Dr. Himangshu Das Director, NIEPMD-Chennai, MSJ&E	
11.00	Tea/Coffee break		
11.30	Inaugural Ceremony		
13.00	Lunch/Poster Viewing		
14.00	Global Disability Innovation Hub and AT Innovation in India	Dr. Catherine Holloway Co-founder & Academic Director, Global Disability Innovation Hub, UK	Chair: Dr. Himangshu Das Director, NIEPMD, Chennai (under MSJ&E) Co-Chair: Mr. Sanjiv Jha Executive President-Indian Association of Physiotherapists
14.30	AT Service delivery systems, practices and outcomes	1. Mr. Dilip Patro, Director-The Ability Foundation Vizag, Andhra Pradesh 2. Ms. Sampurna Guha- Research Scholar RKMVERI-FDMSE, Coimbatore, Tamilnadu	
15.00	Tea/Coffee break		
15.30	Humanitarian Emergency Response & Assistive Technology	Ms. Saija Lukkarinen Physical Rehabilitation Program Manager, ICRC Regional Delegation, New Delhi	Chair: Shri. Jayavibhava Swamy Director, Dept. for the Empowerment of Differently Abled and Senior Citizens Government of Karnataka Co-chair: Dr. Vinaya Anand Suratkal Chief Podiatrist and HOD, Wound Care Centre, Bhagwan Mahaveer Jain Hospital, Bangalore
15.45	Assistive Technology in Geriatrics and Palliative Care	Mr. Kishore Rao Founder Chairman - Karunashraya Hospice and Indian Cancer Society, Karnataka	
16.00	Users perspective on AT	Dr. Amitabh Dwivedi, Dean-Jaipur Occupational Therapy College, Jaipur Mr. Arvind Suresh Ambalapuzha, CEO, Flexmotiv Technologies Pvt. Ltd., IIT Delhi Ms. Priya Mishra, Research Scholar, Dr. Shakuntala Misra National Rehabilitation University, Lucknow, UP Mr. Bart Geilen, Research Intern, Bangalore Baptist Hospital, Bangalore	
16.40	Users perspective on AT: Panel discussion	Panelists: Ms. Rupmani Chhetri, Deaf Outreach Manager /Inkludo Consulting & Advisory, Bangalore Dr. Deepthi Shanbhag, Associate Professor, Dept. of Community Health, St. John's Medical College, Bangalore Dr. M.K. Sridhar, President-Centre for Educational and Social Studies & ICSSR Senior Fellow at ISEC, Bangalore	Moderator: Ms. Kuhu Das, Founder, Association for Women with Disabilities (AWWD), West Bengal, India
17.15	Closing of DAY 1		

DAY 2, Saturday 3rd August 2019			
08.30	Registration/Poster Viewing		
09.30	Gaze-based Assistive Technologies	Dr. Deepak Sharan, Dean, RECOUP Research and Education Foundation, Bangalore	Chair: Shri. K.V.S. Rao Director(R) Department of Empowerment of Persons with Disabilities, MSJ&E, Government of India Co-chair: Prof. Rajesh Shenoy, Syndicate Member, Board of Studies Chairman, RGUHS, Karnataka
09.50	Innovative Assistive Technology Solutions	Dr Shirshendu Mukherjee, Mission Director -Grand Challenges India, Biotechnology Industry Research Assistance Council (BIRAC), New Delhi	
10.10	Human Resource Development and Assistive Technology	Mrs. Smita Jayavant Director, PDUIPH, New Delhi	
10.30	Assistive Technologies in Universal Health Coverage (UHC)	Dr. R. K. Srivastava Sr. Advisor Innovation & Public Health WISH	
11.00	Tea/Coffee break		
11.30	How Advanced Technology is Influencing New Designs	Prof. Dibakar Sen Centre for Product Design and Manufacturing, and Dept. of Mechanical Engg. IISc Bangalore	Chair: Mr. V.S. Basavaraju Commissioner of Disabilities, Government of Karnataka.
11.50	Emerging and Innovative Assistive Technologies with interdisciplinary research	Ms. K. Anusha Saipriya, student of Biomedical Engg., Sri Ramakrishna Engineering College, Coimbatore, TN Mr. Anil Kumar, Zonal Manager, Ottobock-India, Bangalore Mr. Soikat Ghosh Moulic, Associate Director- Technical & Quality systems, MI and Mr. Girish Murthy, Managing Partner, 3D Prototyperz, Indore	Co-chair: Dr Shirshendu Mukherjee Mission Director - Grand Challenges India, BIRAC, New Delhi
12.20	Innovations in different types of biomedical devices	Dr. S. Kanagaraj, Professor and Head, Indian Institute of Technology (IIT), Guwahati	Chair: Dr. Satish Amarnath Head, Quality Compliance and Outreach Services, Manipal Hospitals Co-chair: Mr. Mukesh Doshi, Member, IAAT
12.40	Universal Design	Mr. Ashok Mondal, Faculty of Universal Design, National Institute of Design, Bangalore	
13.00	Lunch/Poster Viewing		
14.00	Assistive Technologies: Idea to Invention to Innovation to Impact	Prof. B. Ravi Institute Chair-Professor of Mechanical Engg. and Founder, BETiC - Incubation Centre, IIT Bombay	Chair: Dr. Sara Varughese Country Director, CBM India Co-chair: Mrs. Smita Jayavant Director, PDUIPH, New Delhi
14.20	Assistive Technology -Make in India	Dr. Sujatha Srinivasan, Prof & Head, TTK Center for Rehabilitation Research and Device Development (R2D2) IIT-Madras (Chennai)	
14.40	Information & Communication Assistive Technology & Make in India	Mr. Ankit Rajiv Jindal, Founder, Friends for Inclusion	
15.00	Evidence based statistical analysis for right to ensure QOL of elderly persons	Mr. Tarit Kumar Dutta Member, IAAT	
15.15	User-centred approach in creating impactful solutions for disabled	Mr. Trivikram Annamalai Senior Designer, Atlassian	
15.30	Tea/Coffee break		
16.00	Panel Discussion and Way forward Shri. K.V.S. Rao Director(R) DEPD, MSJ&E, Government of India Dr. Sara Varughese Country Director, CBM India Dr. Sujatha Srinivasan, Prof & Head, TTK Center for R2D2, IIT-Madras Dr. Gift Norman Head of Community Health, Family Medicine & Palliative Care, BBH Mrs. Smita Jayavant Director, PDUIPH, New Delhi Dr. Gaurav Gupta National Professional Officer (Injury & Disability Prevention), WHO India	Moderator: Mr. Ankit Rajiv Jindal, Founder, Friends for Inclusion	
17.00	Valedictory Ceremony		
18.00	Close of the Conference		

Annex-2 Chairs & Co-Chairs and Moderators for the Various Sessions

Day 1: 2nd August 2019

Dr. Shyam Vasudeva Rao



Dr. Shyama Vasudeva Rao, an engineer by training is the Managing Director-Forus Health Pvt Ltd., Director- MYMO wireless, Co-founder & Director- RenalyX health systems, eHealth enablers and co-founder and Director of Rx Digi Health Platform. His research work on Real Time Systems and parallel computer architecture from the Indian Institute of Science, Bengaluru won him a gold medal and the Prof. Badkas Best Thesis Award. His innovation 3nethra - an all in one eye screening device - has also won several awards. Dr. Rao has published over 40 technical papers, has filed over 25 International patents and holds 5 US patents.

Dr. Himangshu Das



Dr. Himangshu Das is the Director of National institute for Empowerment of Persons with Multiple Disabilities (NIEPMD), a national institute under the Ministry of Social Justice & Empowerment. Dr. Das has over two decades of experience as a bureaucrat. He holds a Ph.D. in Special Education and has published papers in reputed national and international journals. Dr. Das is visiting faculty at various national and international institutes and universities.

Dr. Sanjiv K. Jha



Dr. Sanjiv Jha is the current Executive President of the Indian Association of Physiotherapists. Dr. Jha holds a Doctoral Degree in Physiotherapy, and has over 24 years of extensive clinical as well as teaching experience. He has additional certifications from reputed institutions in UK, Germany and USA. He has presented several research papers at various Conferences, taught over 2500 physiotherapists and guided many research projects. He received the Lifetime Achievement Award from the IAP in 2016 for his contribution to the profession. Dr. Jha is the founder of the Centre for Chronic Disease and Research, Indore and the SS Society for Health and Education.

Shri. Jayavibhava Swamy (KAS)



Shri Jayavibhava Swamy is the present Director, Empowerment of Differently Abled and Senior Citizens Department, Karnataka. He can boast of a long career journey from rural Karnataka to where he is today. Dr. Swamy gained Masters' Degrees in Political Science and Personnel Management. After a 20-year stint in the Indian Air Force, he worked in a city municipal court, the police force, had postings as Asst. Commissioner and then Special DC (Enforcement) for Bangalore and Commissioner of Tumkur City Corporation. Shri Swamy has won both state and central government awards for implementation of programs.

Dr. Vinaya Anand Suratkal



Dr. Vinaya is the first podiatry professional in India. She is currently Chief Podiatrist and Head of the Wound Care Centre at the Bhagwan Mahaveer Jain Hospital, Bangalore, India. She trained at King's College Hospital London, and General Hospital, Leicester, UK with an International Diabetes Federation Fellowship Award. She holds a doctorate in education and guidance, and Master's degrees in sociology, hospital administration and wound care specialisation. Dr. Vinaya has worked from 1997 to date intensively in rural and urban communities. She received the "national award for exemplary achievement 2017" from the Diabetic Foot Society.

Day 2: 3rd August 2019

Shri. KVS Rao



Shri Rao, Director in Dept. of Empowerment of Persons with Disabilities, MSJ&E New Delhi has over 15 years' experience in policy and planning in the health and disability sectors. Shri Rao has provided policy inputs and program oversight towards setting up of a National level Institute for Mental Health Rehabilitation; and creation of a National Database of PWDs to reach the unreached. Shri Rao has worked intensively to ensure convergence of the efforts of various allied Central Ministries and state departments, UN agencies and NGOs to address disability-related issues. His special interests include yoga and meditation, naturopathy and Indian spirituality.

Prof. Rajesh Shenoy



Prof. Rajesh Shenoy is currently a member of the Syndicate, Board of Studies of the Rajiv Gandhi University of Health Sciences. He is a Director of the Padmashree group of Institutions, which has catered to higher education in healthcare and allied health services from 1996. Mr. Shenoy has also been on various committees of the Rajiv Gandhi University of Health Sciences since 2000 and He is also involved in advising on introducing market-relevant courses and curricula for various courses in allied health sciences and in exam reforms in the University.

Shri. V.S. Basavaraju



Mr. Basavaraju is the State Disability Commissioner for Karnataka state. He holds a Diploma in Special Education and a Certificate in Management from Tata Institute of Social Sciences (TISS), Mumbai. He has been working for the cause of PWDs from 26 years. Mr. Basavaraju contributed significantly to further support for the disability sector in Karnataka while heading the well-known NGO, Association of People with Disabilities (APD) from 1997-2017. While also serving the Karnataka Welfare Association for the Blind (KWAB), he helped establish two Rural Community Based projects for persons with disability, besides the Disability NGO Alliance (DNA), a network of over 100 organisations working on disability concerns.

Dr. Shirshendu Mukherjee



Dr. Shirshendu Mukherjee, is Mission Director of the Program Management Unit at Biotechnology Industry Research Assistance Council (BIRAC), a Dept. of Biotechnology and Bill & Melinda Gates Foundation collaboration which manages the BMGF Grand Challenges Program and the Affordable Healthcare initiative in India of the Wellcome Trust. He keenly supports the innovative ecosystem in India and beyond. He is a medical microbiologist by training, with over 25 years of experience in academia, and the pharmaceutical industry. He has served for over 10 years in national and international philanthropic and Government funding agencies. He holds doctoral degrees in Microbiology, Law and Management from the IIM, Kolkata and Oxford University, UK.

Dr. Satish Kumar Amarnath



Dr. Amarnath heads Quality Compliance and Outreach services with the Manipal group of hospitals. Despite loss of vision from an acid attack earlier, Dr. Amarnath has been a tremendous achiever and motivator to all. He has a B.Sc., a Diploma in Industrial Microbiology and a Ph.D. in medical microbiology. After a stint with JIPMER govt. hospital in Pondicherry, he worked with the Manipal group as a Consultant Microbiologist, Coordinator of Distance Education, Chairman of Hospital Infection Control, Quality Management Representative for ISO, and Medical Director for Manipal Cure & Care. With over 50 published research papers and a book on Human Pathology to his credit, he also promotes technological innovation

in medical care delivery.

Shri. Mukesh Doshi



Mr. Doshi is the current President of the Indian Association of Assistive Technologists. He has been working in the field of Prosthetics & Orthotics from nearly 40 years. He has introduced various technologies in this field. He consults with leading hospitals in Mumbai, besides running two private clinics. Mr. Doshi's rehabilitation institute "Jaya Rehab Centre" has received both national and presidential awards for their humanitarian work after the earthquake in Kutch in 2001. His work is not restricted to people - he has a soft corner for animals and is an animal rights activist.

Dr. Sara Varughese



Dr. Varughese is currently Country Director of CBM India. She graduated in medicine from the Christian Medical College Vellore, South India. She is a Fellow of the Royal College of Surgeons, Edinburgh. She also holds a Master's degree in Public Eye Health from the London School of Hygiene and Tropical Medicine. Dr. Varughese earlier served as CBM's Regional Director for South Asia, and also worked with the World Health Organisation (WHO), South East Asia Regional Office. She is the past President of Vision 2020-The Right to Sight India, a national forum for eliminating avoidable blindness. She has authored papers in various reputed journals.

Mrs. Smita Jayavant



Mrs. Smita Jayavant heads the prestigious Pandit Deendayal Upadhyaya National Institute for Physically Handicapped, New Delhi. She is also Member-Secretary of the Rehabilitation Council of India. She has guided theses and dissertations for 2 universities, presented scientific papers at national conferences of AIOTA, AIPMR and WHO Workshops and Seminars; and published over 10 Scientific Papers in peer-reviewed journals. She was a contributor to WHO's manual on community-based rehabilitation. She is credited with setting up a Therapeutic Park in All Indian Institute of Physical Medicine and Rehabilitation campus.

MODERATORS FOR THE PANEL DISCUSSIONS

Ms. Kuhu Das



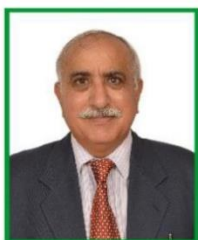
Ms. Kuhu Das is herself a person with disability. She is the founder of Association for Women with Disabilities (AWWD), West Bengal. AWWD focuses on empowerment and mainstreaming of women and girls with disabilities, mainly in rural areas and urban slums. She holds a post-graduate diploma in Human Rights from the National University of Juridical Sciences, Kolkata. Ms. Kuhu Das has worked for the cause of persons with disability from field to policy at State, national and international levels.

Mr. Ankit Rajiv Jindal



Mr. Ankit Jindal, himself a visually challenged person from his teens, went on to gain a degree in Management from the University of Delhi again. He later founded Friends for Inclusion, a non-profit start-up that aims to empower PWDs through assistive technologies. He also co-founded Diversity and Equal Opportunity Centre (DEOC), a consulting and support organization providing services to organizations in diversity education and research. As A Youth Icon with disability, Mr. Jindal was invited to speak at the United Nation's Conference of State Parties in 2015. He is a member of the National Committee for Disability. He currently works as a marketing specialist for a Fortune 500 company. As a thought leader in inclusivity, he co-authored a manual for the Confederation of Indian Industry and published articles and opinion pieces in The Hindu, Mint and other leading Indian dailies. He received NCPEDP's Helen Keller Award in 2013.

Annex-3 List of Speakers and Topics



Dr. PATANJALI DEV NAYYAR
Consultant NDE/ WHO-SEARO
New Delhi

Email: nayarp@who.int;
Skype drnayar

“GLOBAL DEVELOPMENT ON
ASSISTIVE TECHNOLOGY”



Ms. SAMPURNA GUHA
Research Scholar (Ph.D.)

RKMVERI-FDMSE, Coimbatore
Email: sampurnaguha@gmail.com

“ASSISTIVE TECHNOLOGY AND
INTELLECTUAL DISABILITY”



Dr. GAURAV GUPTA
NATIONAL PROFESSIONAL OFFICER
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“ASSISTIVE TECHNOLOGY IN
GERIATRICS AND PALLIATIVE CARE”



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“EXPLORING BARRIERS TO THE USE OF
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“ROLE OF AT IN SCI - HEALTHY AND
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“AN IN-DEPTH USER STUDY ON
PROBLEMS FACED BY AXILLARY CRUTCH
USERS IN INDIA”



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 “PERCEPTION TOWARDS USE OF AT IN
 HIGHER EDUCATION: A CASE STUDY”



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 “ASSISTIVE TECHNOLOGIES IN
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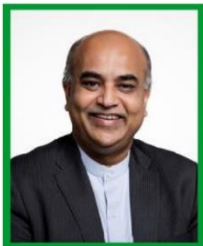
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 “A WHEELCHAIR IN RURAL
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“ENABLING FABRICATION OF P&O
DEVICES WITH ADDITIVE
MANUFACTURING VIA DIGITAL
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“INNOVATION IN DIFFERENT TYPES
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Annex-5 List of Poster Presentations

SL. NO.	NAME OF THE PRESENTER	TITLE
THEME: AT SERVICE DELIVERY SYSTEMS, PRACTICES & OUTCOMES		
1	Ms. Radhika RP Assistant Professor in Dept. of Optometry, Manipal college, Karnataka	Effect of mobile-based 3D virtual reality on tear film characteristics and accommodative response
2	Mr. Jarapla Srinivas Nayak Physiotherapist in NIMHANS, Bangalore	Effect of a Low-Cost LASER Mounted Walking stick over the temporal and spatial gait parameters in Parkinson's disease-A case study
3	Mr. Hemaraja Nayaka Assistant Professor, Unit of Audiology & Speech-language Pathology, Yenepoya Medical College, Deralakatte, Mangalore, Karnataka	An android application-based delayed auditory feedback (DAF) intervention for persons with stuttering
4	Mr. Nityananda Samal Prosthetist & Orthotist, CRC, Bhopal	Osteoarthritis hinged knee brace
5	Dr. Neha Singh Mandade Assistant Professor, Maharashtra Institute of Physiotherapy, College of Physiotherapy, Maharashtra	Efficacy of Pranayamic breathing on cognition and balance in Parkinson's patients
6	Dr. Pallavi. Dangat In-charge Principal, Maharashtra Institute of Physiotherapy, College of Physiotherapy, Latur Maharashtra, India	Impact of sarcopenia on quality of life in an elderly population
7	Dr. Karthikeyan. T Physiotherapist in NIMHANS, Bangalore	Therapeutic efficacy of open versus closed kinetic strength training with bilateral AFO for the treatment of spasticity diplegics gait conditions-comparative study
8	Mr. Una Dilip Kumar Patro Director -The Ability People, Vizag	Role of AT in SCI-Healthy and Hygienic bladder & bowel management
9	Dr. Pradnya Yashwant Dumore MPT Student, Dr. Vithalrao Vikhe Patil College of Physiotherapy, Ahmed Nagar	Risk of fall in community dwelling elderly individuals-cross sectional study
10	Dr. Pratima Sudhir Sarwadikar MPT Student, Dr. Vithalrao Vikhe Patil College of Physiotherapy, Ahmed Nagar	Association of physical activity and quality of life in elderly diabetic patients from rural community-a cross sectional study
11	Mr. Rajdeep Kumar Senior Manager - P&O Training, Mobility India, Bangalore	WHO guideline on wheelchair provision and a study on integration in the curriculum of P&O rehabilitation professionals
12	Ms. Gusain Pranaita Occupational Therapist, BHDC, Delhi	Applications: Emergence in AT
13	Mr. Jenish. J BPO final year student, Mobility India, Bangalore	Use of Smart materials in Assistive Technology
14	Mr. Vicky Dey BPO Internship student, Mobility India, Bangalore	Easy lock suspension system for below knee amputee
15	Mr. Vineeth Tummalapalli Jr. Occupational Therapist, PMR Department, St. Johns Medical College and Hospital, Bengaluru, India	Impact of early and effective rehabilitation to improve function in a patient with HIE: A case study
16	Ms. Reeya Thampi/Ms. Fariha Iqbal BPT 3rd Year students, St. Johns National Academy of Health Sciences, Bengaluru, India	A comparative analysis on influence of wrist position on grip strength in splinted versus non splinted dominant hand
17	Mr. Haritha. A Lecturer, St. John's Medical College & Hospital, Bengaluru	Effect of ten months intensive multi-disciplinary approach for one month post traumatic brain injury patient with GCS score of 3/15 – a case report.
18	Ms. Shivani John BPT 3rd Year students, St. Johns National Academy of Health Sciences, Bengaluru, India	Highlighting the importance of systemic approach for rehabilitation of a transfemoral amputation during pre-prosthetic period: A review
19	Dr. Kuzyakina Alina Sergeevna Doctor of Rehabilitation Medicine, Prosthetics Department, LLC Motorica, Russia	Innovative approach in Upper limb prosthetics and rehabilitation

THEME: USER PERSPECTIVE ON AT		
20	Ms. Shobha N. Odunavar Asst. Professor, Department of Special Education, NIEPMD Chennai	Perspective of Individual with Deafblind about Assistive Technology
THEME: EMERGING AND INNOVATIVE ASSISTIVE TECHNOLOGIES WITH INTERDISCIPLINARY RESEARCH		
21	Mr. Karthik Venkat Sridaran Speech Technologist in AIIISH, Mysuru	A Low cost AAC device using "blow-slurp" technology
22	Ms. Judith Shefali Jathanna Assistant Professor in Dept. of Optometry, Manipal College, Karnataka	Effect of Metronome and balance board on pursuits and hand eye co-ordination
23	Mr. Vishnu Vijayan BPO 4th year student, Mobility India, Bangalore	Passive finger extension dynamic hand splint
24	Mr. Kapil Nishad Student of P&O in PDUNIPPD, New Delhi	Indigenous Smart Wheels
25	Ms. Heavenna Babu Senior Co-ordinator, APD Bangalore, India	Clinical Integration of 3D printed postural support devices for wheelchairs
26	Ms. Kasthuri.G Project Officer, Assistive Technology @IIT Madras	Affordable Assistive Devices
27	Mr. Subrata Kumar Halder Sr. Occupational Therapist cum Jr. Lecturer, SVNIRTAR, Orissa	Development of cost effective custom made "Adjustable postural correction chair" to improve posture and motor behaviour for cerebral palsy children
28	Ms. Apurva. S 4th BE student, Biomedical engineering Sri Sivasubramaniya Nadar College of Engineering Chennai, Tamilnadu	Orthopaedic belt using sodium acetate crystals
29	Mr. Praveen Kumar.G 4th BE student, Biomedical Engineering Sri Sivasubramaniya Nadar College of Engineering	Composite blades for lower extremity amputees
30	Ms. Kesiya.M ME student, Biomedical Engineering, Sri Sivasubramaniya Nadar College of Engineering	A knee brace for Genu recurvatum
31	Mr. Viswanath 4th BE student, Biomedical Engineering Sri Sivasubramaniya Nadar College of Engineering	An external aid for cerebral palsy (CP) and dropping head syndrome (DHS) patients
32	Mr. Akash Narayana Senior Data Architect, Rx Digihealth Platform Pvt. Ltd	Preventive Healthcare
33	Mr. Nishant Agarwal Project Engineer, IIT Kanpur	Development of a Multi-Fingered Prosthetic Hand Mechanism for Trans-Radial Amputee: Adaptive Grasp and Pinch
34	Mr. Anand Kutre Founder Director, True Consultancy, Bengaluru	Assistive Technology – Mobility (TurnPlus)
35	Mr. Ezhumalai BPO 4th year student, Mobility India, Bangalore	Prosthetic management of shoulder disarticulation amputee: A case study approach
36	Mr. Kamaraj.V Manager-P&O Training, Mobility India Bangalore	User evaluation of satisfaction with innovative twin device used by children with delayed developmental milestones
37	Mr. Ahmad Issam Mawla BPO Internship student, Mobility India Bangalore	Triple Action lock for manual wheelchair
38	Mr. Shukkur Thaha BPO Internship student, Mobility India Bangalore	Adjustable tube clamp adapter for lower limb prosthesis
39	Mr. Rajesh Ramachandran Research Officer, NIEPMD, Chennai	Low-cost adapted recreational activity toy for children with Multiple Disabilities

Use below link to access the abstract of Poster presenters, page 79-101

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Annex-6 List of Exhibitors

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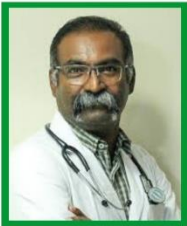
Annex-7 List of Panel of Judges for AT Conference Awards



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Annex-8 Glimpses from the Conference



L-R: Dr. Himangshu Das-Director NIEPMD, Dr. Surinder Singh Oberoi-ICRC, Delhi. Dr. Ashish Mukherjee-Organising Chairperson, Ms. Soumya Reddy-MLA Jayanagar Constituency, **Dr. S.Sacchidanand-Vice Chancellor-RGUHS, Karnakata**, Shri. Charles Prabakar-President MI, Shri V. S. Basavaraju-Commissioner for Disabilities, Mrs. Albina Shankar-Executive Director MI, Dr. Patanjali Dev Nayar-WHO SEARO and Mrs. Laxmi Nataraj- Corporator-JP Nagar representative during the Inaugural Ceremony of National Conference on Assistive Technology for All 2030.

Please use the link below to access the conference photographs.

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