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ORIGINAL ARTICLE

Processes of assistive technology service delivery in Bangladesh, India and Nepal: a critical reflection

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ABSTRACT

Purpose: This paper critically reviews and reflects on the processes for providing Assistive Technology (AT) services to Persons with Disabilities (PWD) in Bangladesh, India and Nepal. The aim is to investigate the AT service delivery systems in these countries and suggest improvements where weaknesses are identified.

Materials and methods: We carried out a descriptive qualitative exploratory study in Bangladesh, India and Nepal by conducting key informant interviews with policymakers (5), AT service providers (22) and mobility and hearing related AT service users (21). We used a directed content analysis approach guided by a seven-point AT service delivery process model to thematically analyse the existing processes for AT service delivery, from first contact through to follow-up and maintenance.

Results: AT service delivery processes are sub-optimal in all three countries, and improvements are needed. No common AT service delivery process was found, although there are common features. In general, it is easier for PWDs in India and Nepal to access AT than for those in Bangladesh, but all three countries are failing to live up to their commitments to uphold the human rights of PWDs.

Conclusions: Although good elements of AT service delivery processes can be identified, the systems in all three countries are fragmented and generally weak. A more holistic approach of looking at the process of AT service delivery, from first contact right through to follow-up and device maintenance, with a single door service delivery system, free of cost at the point of service is recommended in these countries.

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➤ IMPLICATIONS FOR REHABILITATION

- Although we found significant weaknesses in AT delivery in all three countries, there are some good AT service delivery practices and opportunities for these countries to learn from one another.
- A systematic and stepwise approach to assessing current AT service delivery processes in the three countries – examining the delivery system as a whole, from initiation to repair and management – can help identify opportunities to improve the process for (prospective) AT users.
- A more coherent single door system of AT service delivery will increase the quality and efficiency of the fragmented AT service delivery practices in Bangladesh, India and Nepal.

Introduction

Similar to the World Health Organization [1], the Association for the Advancement of Assistive Technology in Europe (AAATE:www.aaate.net) defines Assistive Technology (AT) as "*an umbrella term indicating any product or technology-based service that enables people of all ages with activity limitations in their daily life, education, work or leisure*" [2]. Scherer [3] highlights the importance of AT service delivery systems as "*Assistive technology (AT) service delivery (ATSD) takes place within an AT system. The components of this system include users and their families, AT products, AT services, personnel, service providing agencies, manufacturers, distributors, funding agencies, and policies and legislation*" [3]. An "AT system", therefore, includes a wide range of activities and processes, from the making of policies related to AT to ongoing support for AT users [4–6] – and everything in between.

Effective AT systems play a part in reducing inequalities and help PWDs live healthy, productive, independent and dignified lives [7]. Ineffective AT systems, meanwhile, can result in underuse of services and wasted resources [5,7–9]. Access to AT services has been recognized as a fundamental human right of PWDs [10].

A systematic AT service delivery system has been common in most European countries for many years [2,9], but that is less often the case in developing countries such as Bangladesh, India and Nepal. As Andrich et al. [2,9] have highlighted, it is impossible to design a standardized AT service delivery system for multiple

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countries, but the minimum components of a workable system can be identified, with the implementation of those components adapted for individual country contexts. The HEART (Horizontal European Activity on Rehabilitation Technology) study was the first of its kind to emphasize the importance of the models of AT service delivery systems in Europe [2,11].

The HEART study also resulted in a process model of AT service delivery, based on an analysis of the AT service delivery systems and processes in 16 European countries [2,9,11]. This model describes the process in 7 basic steps: (i) Initiative (the first contact with the service delivery system), (ii) Assessment (evaluation of needs), (iii) Selection of the assistive solution (defining the individual AT program), (iv) Selection of the equipment (choosing the specific equipment within the AT program), (v) Authorization (obtaining funding), (vi) Implementation (delivering the equipment to the user, fitting and training), and vii) Management and follow-up (maintenance and periodic verification) [12]. Maclachlan and Scherer [13] used a 10 P model to schematically visualize different aspects of assistive technology systems. This model diagrammatically presents people (PWDs in this case) at the centre of the system, surrounded by provision, personnel, products and policies, which are further surrounded by procurement, promotion, pace, partnership and place. This model has been found to be useful for investigating broad system issues rather than examining the AT service delivery processes.

Since the 2006 United Nations Convention on the Rights of Persons with Disabilities (CRPD) mandated access to AT services for people in need of such services [14], Bangladesh, India and Nepal have formulated various policies and laws, and have allocated funding, in an attempt to improve their AT systems, to benefit service users and to meet their international human rights obligations. However, despite these commitments and clear evidence of the benefits of a well-functioning AT service delivery system [4,12,15], there is still a lack of evidence on the effectiveness of AT service delivery processes in these countries. Therefore, it is important to look in more detail at current practices to identify areas where improvement is required – as well as areas of good practice – to promote well-functioning AT service delivery systems and to identify opportunities for learning among these neighbouring countries. This study starts from the experiences of users themselves [16–22], taking a "bottom-up" look at the system, instead of the more common top-down one. However, we also examine how AT service providers and policy makers/implementors perceive the AT service delivery process. Because of their role on the "supply side" of AT service delivery, AT service providers and the policy makers may experience the AT service delivery process differently to AT service users. Therefore, to understand the AT service process wholistically it is important to understand how these later stakeholders understand this process.

In this study, we seek to answer the following research questions:

1. What are the processes prospective AT users have to follow to access hearing and mobility related AT services in Bangladesh, India (Bangalore) and Nepal?
2. What are the commonalities and differences in AT service delivery processes in Bangladesh, India and Nepal?
3. In which steps of the processes did participants identify evidence of good practice, and where did they see weaknesses?
4. What can Bangladesh, India and Nepal learn from each other to improve their current AT service delivery processes?

Our approach to examining AT service delivery processes from the perspective of users made the seven-step HEART process model especially suitable for our study, as it reflects the ways in which AT service users experience and understand the system they need to navigate in order to gain access to services. More complex systems-thinking models such as 10 P are less intuitively understood by service users. Analytically, the HEART model's simplified approach can also make it relatively easily implementable by governments: they can look at the linear steps of the process and identify "weak links in the chain" to address much more easily than they could deal with a model that highlights complexity and non-linearity.

Our aim in this paper is not to assess service quality, but rather to critically review and reflect on the *processes* for providing AT services to PWD in Bangladesh, India and Nepal, as experienced by service users themselves and as perceived by other AT system stakeholders – including policymakers and service providers. Utilizing the 7-step HEART process model, we seek to identify areas of relative strength and weakness, and suggest improvements where weaknesses are identified.

Method of enquiry

We applied a descriptive qualitative content analysis approach [23] and Consolidated Criteria for Reporting Qualitative Studies (COREQ) [24] to conduct and report our study. We chose a qualitative research method because this research needed an in depth understanding [25,26] of AT services and users' experiences as our starting point, from first contact with the AT service delivery system to the final management and follow up plan at the end of service delivery. To gather data on current practices of service provision and use of AT, we conducted 15 Key Informant Interviews (KIIs) in Bangalore, India (IN), 16 in Bangladesh (BD) and 17 in Nepal (NP) with policymakers (ATPM) (5), AT service providers (ATSP) (22) and AT service users (ATSU) (21). Sixteen (33%) of the 48 interview participants were female (see demographic details in Table 1).

The interviews were conducted in January and February 2020. Some participants had multiple roles, such as government employees who have been involved both in policymaking and service delivery, or service providers who are themselves AT users. Each interview lasted between 30 and 60 min. We also made observational notes during visits to service delivery centres while observing AT service delivery processes in Bangladesh, India and Nepal, as well as during the interviews. We focussed our study on mobility and hearing related AT services and users, but most of our findings will have broader applicability to other forms of AT.

Since the first author and co-authors from India and Nepal were still actively involved in delivering AT services in their respective countries, we needed to be extra careful to remain neutral and unbiased during the KIIs in these countries. However, it was easier to contextualize the views expressed by the respondents, still remaining neutral.

Table 1. KII participants.

Country	Policy maker	Service provider	AT user
India	2 (KII ATPM_IN) (2 male)	8 (KII ATSP_IN) (2 female, 6 male)	5 (KII ATSU_IN) (4 female, 1 male)
Bangladesh	2 (KII ATPM BD) (1 female, 1 male)	4 (KII ATSP BD) (2 female, 2 male)	10 (KII ATSU BD) (3 female, 7 male)
Nepal	1 (KII ATPM NP) (1 male)	10 (KII ATSP NP)* (10 male)	6 (KII ATU NP) (4 female, 2 male)

*Seven of the 10 service providers interviewed in Nepal used AT devices.

Sample

Since this research is focussed on mobility and hearing related Assistive Technology, we purposively selected KII participants with the help of our in-country partners to enable the researchers to gather rich information about mobility and hearing aid related AT, the PWDs these AT are provided to, and existing processes of AT service delivery. In all three countries we interviewed (i) AT service users (mostly mobility and hearing aid related AT service users – ATSU); (ii) AT service providers (mostly government/NGO AT service providers – ATSP) and (iii) AT service policy makers/ implementers (mostly current or retired government employees – ATPM). The in-country partners contacted possible participants from these three categories one or two weeks before commencing the interviews, explained the research to them, and asked whether they were interested and prepared to be interviewed. Once the participants agreed to be interviewed, they were visited by the researcher (first author) together with the in-country research assistants to interview. The interview participants had option to decline to be interviewed at any stage of the interview i.e., from initial contact by the in country research assistants until the completion of interview without any consequences, which was clearly explained to the interview participants and strongly followed.

Fieldwork was undertaken in Bangalore in India; Kathmandu, Lalitpur, Pokhara and Surkhet in Nepal; and Dhaka in Bangladesh. Preliminary research and consultations with in-country partners suggested that whilst processes are relatively similar countrywide in Bangladesh and Nepal (even if the actual experiences of users can vary greatly, for example between rural and urban areas), the federal system in India means that systems vary dramatically across different states. Bangalore was selected as a focus for the India arm of the study as it is reputed to have one of the well developed AT service delivery systems in India, and therefore serves as a "best case" example from which best practice ideas (as well as weaknesses) can be identified.

Ethical considerations

Prior to data collection, we obtained ethical approvals from the University of Sheffield (UK), Nepal Health Research Council, the Ethics Review Board of Bangalore Baptist Hospital (India), and the Ethics Review Board of the Centre for Injury Prevention and Research (Bangladesh). We informed participants about the research, the voluntary nature of their participation, and their right to withdraw from the interview at any time. We explained the objectives of our study along with our affiliations, interest and qualifications before commencing the interviews. The first author was always accompanied by a research assistant during each interview, and family members of the participants were present in some cases. We obtained written consent before the start of each interview and verbal consent was obtained to audio record the interviews. We conducted interviews either in English or local languages, as preferred by the participant.

Data collection and data analysis

An interview guide was prepared and piloted with four AT service users in Nepal before finalizing the guide. No major changes were made to the interview guide after the piloting. Separate sets of interview guides were prepared for policymakers, service providers, and users. The interview guides were prepared first in English and then translated into Nepali, Bangla, and Kannada in Nepal, Bangladesh, and India, respectively. Interviews were conducted in local languages, i.e., Kannada, Nepali, and Bangla in India (Bangalore), Nepal, and Bangladesh, and audio recorded. The interviews lasted from 30 to 65 min. All the audio records were transcribed into the respective local languages and translated into English. Since we wanted to capture the views of three different groups of participants from three countries, no data saturation was considered. Neither the repeat interviews were conducted nor the transcripts returned to the participants for comment and/or corrections. Field notes were made to capture the context of the data collection.

Two co-authors coded the interview data using the NVivo 12 qualitative data management software. For consistency, reliability and validity of the findings, these authors independently coded the transcripts and subsequently reconciled differences in their coding for the analysis stage. We used a direct qualitative content analysis approach to analyse our data, as outlined by Hsieh and Shannon [23], using the HEART seven-step service delivery process model as the framework of analysis. We coded the transcripts according to these steps; followed by identifying similarities and differences among the three countries; and respondents' perceptions of good practice and weakness in relation to particular steps in the process.

For reasons of space, the summarized findings from participants against each step of the service delivery process in each country are presented along with interview quotes and participant numbers in the Table 2. The complete code book (including the original participant quotes) is available upon request to the corresponding author.

Results

Drawing on from the key informant interviews with the 48 participants as outlined in Table 1 below we present our findings on the existing AT service delivery processes in Bangladesh, India and Nepal against the HEART seven-step AT service model in Table 2.

To summarize, our results show the AT service delivery processes are neither smooth nor linear in Nepal, India, and Bangladesh. It is common in all three countries that the first contact of the prospective AT service users is through the mainstream health or education system. Other common initiatives are through periodic camps run by different health services and AT service providers. Often, the assessment of the AT requirement, if any, takes place in the health facilities, whereas the selection of solutions and selection of equipment varies depending upon the complexity of the AT solutions needed. Authorization (approval of funding) for an AT solution for a prospective user was a very complex process in all three countries, often demotivating the prospective user to follow the process, leading either to out-of-pocket expense to purchase the services or not using the AT services at all. There were no systematic practices and plans for the repair and maintenance of the AT solutions. The users on an *ad hoc* basis mostly did it in all three countries. Regular government funding for AT services was better planned and provided annually in India and Nepal compared to Bangladesh, whereas both in India and Bangladesh, local artisans were trained to repair the AT devices and common materials such as bicycle tyres, bearings were used in AT devices such as wheelchairs. Therefore, we found that there are challenges in AT service processes in each country, but there are some good aspects in each country that can be learnt from each other.

We present the commonalities and differences between AT service delivery practices in Bangladesh, India and Nepal against

Table 2. Interview quotes against the HEART 7 step AT service delivery model.

Process	Nepal	Bangladesh	Bangalore, India
1. Initiative	*The first contact with the system can be through various routes, including: peer groups (ATU_NP_3); word of mouth (ATSP_NP_5, 6, 7); family members; the education or health systems (ATU_NP_1); or a health camp – often while attending for other health problems (ATU_NP_3, 5, ATSP_NP_4).* *DPOs (Disabled Peoples' Organizations) advocate for a local level database of PWDs which would help prospective AT users, but such a system is not implemented systematically or regularly (ATU_NP_4). In special cases such as leprosy, which causes disability, (prospective) AT users are identified and assessed when they come for treatment (ATSP_NP_3). It is the responsibility of the local authority to identify and maintain data on PWDs and prospective AT users. It is the responsibility of prospective users to register with the local authority (ATPM_NP_1).*	*The first contact with the system can be through various routes, including: peer groups and family members (ATSU_BD_4, 5, 7, 9); camps; leaflet distribution; social media; radio or television awareness campaigns; or NGO workers (ATSU_BD_1, 8, 7, 6, ATSP_BD_4).* *Disability is often identified when people attend health services for other problems (ATSP_BD_3, 5, ATSU_BD_10, 6). In some cases (e.g., after an accident that causes disability) it can take PWDs a long time to discover where they can access AT services, in some cases up to 4–5 years (ATSU_BD_2, 4, 5, 8).* *Service providers identify the lack of disability awareness amongst family members as one of the biggest hurdles to access (ATSP_BD_5, ASTU_BD_5). Service users also saw this as a cause of delays in access to AT services (ATSU_BD_6, 9) – especially for those in remote areas (ATSU_BD_1, 9).* *The Ministry of Social Welfare sometimes assesses prospective AT users through house-to-house visits (using Washington Group Tools), but at the time of data collection this was being piloted only in one sub district, and Government often relies on the charity sector for this task (ATPM_BD_1, ASTP_GO_BD_3).*	*Community-level Anganwadi workers (early childhood workers), ASHA workers (community health volunteers), or VRW (village rehabilitation workers) based in the community are generally the first point of contact for PWDs, and can refer them to the DDRC (District Disability and Rehabilitation Centre), MRW (Multi Rehabilitation Worker) or other services – which are sometimes delivered through camps (ATPM_IN_1, 2, ATSP_IN_3, 4, 6, 7, 8, 9, ATSU_IN_1, 3, 4, 5). Visible disabilities are identified early and easily by the family, school or health facilities during vaccination and other regular health interventions, or through screening camps or door to door visits (ATSP_IN_2, 5, 7, ATSU_IN_1).* *PWDs often hear about the screening camps (which provide assessment, preliminary measurements, cost estimate etc) from their peers or social media (ATSP_IN_9).* *VRWs conduct door-to-door visits to see if there are any PWDs not reported, and if found refer to the DDRC (ATSU_IN_1).* *ASHA workers and Anganwadi workers often get training from the DDRC in how to assess PWDs (ATSP_IN_5), and NGOs also provide training in how to identify PWDs (ATSP_IN_8).*
2. Assessment	*There is no systematic structure for the assessment and evaluation of PWDs and their AT needs, which are often rather haphazardly decided (ATU_NP_4). However, it was reported that this is improving, and prospective AT users are being better informed about the possible causes and effect of treatment / operations etc, especially when they visit health camps. At these camps they are assessed properly and advised to revisit if required (ATU_NP_1, 2, 4, ASTP_NP_4).* *Some specialist hospitals and service centres assess the needs of PWDs, plan for treatment if needed, and provide personalized AT devices with a systematic assessment (ATSP_NP_8).* *Lack of awareness among prospective AT users is one of the challenges for initiation and assessment (ATSP_NP_1).*	*Some AT centres do proper needs assessments by professionals such as physiotherapists, either at the centre or during camps (ATSU_BD_3, 5, 6, 10, ATSP_BD_5).* *When people visit hospitals for treatment of other disease or disability, assessments are done or they are referred to where such facilities are available (ATSU_BD_8, 3). There are no AT specialists in Government health facilities, which means that PWDs cannot be assessed there and must be referred elsewhere (ATPM_BD_ 3).*	*PWDs are assessed by rehabilitation professionals such as physiotherapists or speech and hearing therapists, either at the DDRC, hospitals, at a camp, or during NGO interventions (ATPM_IN_1, ATSP_IN_2, 3, 8, ATSU_IN_3, 4, 5).* *Often it is VRWs who collect PWDs and bring them to MRWs at the DDRCs or camps for professional assessment (ATSP_IN_4).* *Assessments are conducted at the Gram Panchayat (municipality) level with the help of VRWs and MRWs (ATSP_IN_5).* *However, the assessment process requires certain documents such as proof of nationality which many PWDs lack. This hinders their access to AT services (ATSP_IN_7).* *A lack of trust in the quality of government services means that some PWDs prefer to visit private AT centres for assessment (ATSU_IN_4).*
3. Selection of the assistive solution	*Especially for AT devices such as orthosis and prothesis, professionals are involved in the selection of the appropriate AT devices (ATU_NP_2, ATSP_NP_1).* *Certain hospitals and AT centres perform corrective surgeries, and design and fabricate AT solutions as*	*AT centres (often staffed by AT users) take care of selection of the appropriate AT solutions (ATSU_BD_7). Sometimes when people visit AT centres for someone else, they get an idea of AT devices for themselves and get assessed for the possible solutions and equipment (ATSU_BD_6).*	*Preliminary assessment and selection of equipment is done at the DDRC, camps, NGO AT centres, or health facilities (ATSP_IN_2).* *MRWs and professionals at the DDRC assess and select the required AT solutions for prospective users (ATSP_IN_5, 6). However often the*

(*continued*)

Table 2. Continued.

Process	Nepal	Bangladesh	Bangalore, India
	per the needs of the person (ATSP_NP_4, 6, 7, 8) – but these facilities are not sufficient to meet needs. A lack of trained professionals makes AT selection difficult (ATSP_NP_7).		*measurements provided by the MRWs are not accurate, which creates difficulty in selecting appropriate solutions and equipment etc. (ATSP_IN_6).* *Some private / NGO AT centres have professionals who assess, select AT solutions, select equipment and deliver the equipment (i.e., steps 2–4, 6) (ATSP_IN_8).*
4. Selection of the equipment	*AT users (especially wheelchair or hearing aid users) often must use what is available rather than what is best for them (ATSP_NP_1, 4, 5,6, ATU_NP_4, 5). Even for specific requirements such as cerebral palsy, AT users are generally provided with a standard wheelchair without a neck and head rest (ATU_NP_4).* *In some specialist care and AT centres the equipment is either suggested by the medical officer or a physiotherapist (ATSP_NP_1, 8), and specialist centres supply personalized devices – mainly prosthesis and orthosis (ATSP_NP_7).* *If service use is initiated through a camp, the initial assessment, selection of AT solution, and selection of equipment (steps 2–4), as well as discussion of possible sources of funding, happen all together at the camp level.* *For complex cases that need personalized AT solutions (including prothesis and orthosis), prospective users must come to the AT service centre with funding. There they are measured, the AT solution provided and tested, and training in use is provided (steps 4, 6) (ATSP_NP_1). The director of the organisation decides on the financial support (step 5) if needed (ATSP_NP_7).* *AT centres are mostly operated by NGOs or private hospitals. The Government of Nepal has not established any rehabilitation centres, except one run by the Nepal Army (ATPM_NP_1).*	*AT devices such as wheelchairs are mass purchased and distributed by the operation division (ATPM_BD_1).* *Some AT centres provide personalized AT devices (e.g., orthosis and prosthesis) and user training (ASTU_BD_3). In these cases, AT centre professionals often make the equipment (ATSU_BD_3).* *It is often medical doctors who conduct the assessment and selection of equipment (ATPM_BD_1), and sometimes the wrong choice of equipment makes users suffer more than without it (ATSU_BD_2, 7).* *Government does not have the resources to provide complex equipment, only basic equipment such as wheelchairs and sticks (ATPM_BD_1).* *Specialist support for the assessment and selection of AT equipment are mostly handled by NGOs (ATPM_BD_ 3, ATSU_BD_5).*	*At the DDRC, where the majority of PWDs get their devices, professionals select the appropriate devices, supervised by the District Disabled Welfare Officer (ATSP_IN_2, 5, ATSU_IN_3).* *However, Government providers often offer standard devices without personalisation because of a shortage of professionals to assess, measure, select and provide AT solutions (ATSP_IN_9).* *In emergency situations (e.g., when people become disabled due to an accident and are taken to hospital), assessment, selection of AT solutions and selection of equipment and arrangement of funding (steps 2–5) takes place under the same roof (ATSU_IN_4). This is what most AT users prefer (ATSU_IN_5).*
5. Authorisation	*Most AT users have to purchase their AT solutions out of pocket (ATU_NP_5).* *The Government allocates a budget to purchase equipment, which is distributed through DPOs, but the funding is not enough to meet the demand and therefore not accessible to everyone (ATU_NP_4, ATSP_NP_2, ATPM_NP_1).* *In the case of ordinary AT services such as wheelchairs, walking aids, sticks, hearing aids etc, the Rural Municipality chair decides the total budget and allocates to users. For personalized equipment, cost estimates are done by the professionals, but the budget still*	*The Government purchases wheelchairs and crutches through tender and distributes them among 492 Upazilas (sub districts) (which equates to only 2–3 sets for a population of about 200,000). (ATPM_BD_1). To access these devices, there are various steps a PWD must go through: identification of the disability; obtain an ID card; undergo an assessment. Each step involves signatures from Government officials (ATPM_BD_ 3).* *The disability allowance can be used for AT services, but there is no separate funding for AT from the Government (ATSU_BD_10).* *To get a disabled allowance, PWD need an ID card, which involves visiting*	*Funding for AT services often comes from the Government, although sometimes services are contracted out to NGOs. There are MP (Member of Parliament) funds, MLA (Member of Legislative Assembly) funds and funds from CSR (Corporate Social Responsibility): each department needs to allocate 5% of their budget for PWDs annually. However, the allocated budget is never sufficient to meet the needs (ATPM_IN_1, 2, ATSP_IN_2, 3, 4) and Government does not always provide what they say they will provide (ATSP_IN_9).* *The District Commissioner releases the funds and the Director needs to sanction the fund (ATPM_IN_2, ATSP_IN_4).*

(*continued*)

Table 2. Continued.

Process	Nepal	Bangladesh	Bangalore, India
	needs to be approved by municipality personnel (ATU_NP_4, ATPM_NP_1). A recommendation letter is obtained from the Ward Office, signed by the Ward Chair, and needs to be taken to the district hospital doctor to make a disability identity card. This card needs to be taken to the hearing aid distribution organisation to get the device (if available) (ATU_NP_1). *Some hospitals and charities provide AT services only to their clients or members, which prohibits others from accessing services from these providers. In these cases, it is the head of the organisation that authorizes the provision (ATSP_NP_8).* *Funding is often ringfenced for a certain type of AT devices, for PWD with specific degree of disability, or for people from a certain geographical area (ATSP_NP_8).* *Complex bureaucracy also prevents PWDs accessing funding. For example, they need to get a disability card from the district from where they got their citizenship, not from where they currently reside (ATU_NP_3).* *No funding is provided by the Government for hearing aids (ATU_NP_1), which are either donated by charities or purchased out of pocket.*	*the voting office with a photo, birth certificate and other documents (ATSU_BD_5, 10).* *Frequently, government funding is not available and the prohibitively high out of pocket cost means that families decide against AT (ATSU_BD_10, 9).* *There is no funding to cover ongoing repair and maintenance costs (ATSU_BD_7).* *Often AT users get their AT devices from charities (ATSU_BD_1).*	*Frequently the money allocated for the device by the Government is insufficient (ATPM_IN_2, 3). The difference is sometimes paid by NGO providers (ATSP_IN_2).* *The DDRC often refers cases to private providers, which is not always affordable for users (ATSP_IN_6).* *PWDs need a disability ID card to access Government resources but getting a card can be a battle (ATSP_IN_8) and corruption as well as commissions can hinder people accessing AT solutions (ATSU_IN_1).*
6. Implementation	*Basic training and a tool kit are provided to wheelchair users at the time of purchase or handover of the wheelchair. A more detailed trial and fitting is provided in more complex cases such as cerebral palsy, or deformity due to leprosy (ATSP_NP_8).* *Detailed assessment, measurement, fabrication, fitting, testing and trials are done at some specialist AT centres, but it is not a norm in most cases, where the AT users purchase their devices from the private suppliers or shops (ATSP_NP_8).* *The Ministry of Women, Children and Social Welfare & the Ministry of Health both are responsible for (ATPM_NP_1, ATSP _NP_4, 5) work for PWDs in Nepal (ATPM_NP_1, ATSP _NP_4, 5) which creates confusion and conflict of interest in who is responsible for what.*	*Some AT centres still follow a systematic procedure of need assessment, measurement, casting, trial, testing and fitting of AT devices (ATSU_BD_7).*	*A lack of appropriate professionals creates difficulties in implementation (ATSP_IN_4). Often standard devices provided are not suitable for day-to-day use (ATSU_IN_2).* *Selection of inappropriate equipment causes problems to users (ATSU_IN_4, 5).*
7. Management and follow-up	*Some respondents reported that there are not enough repair services for wheelchairs or hearing aids in Nepal (ATU_NP_4) (ATU_NP_5). For example, repair and maintenance of more complicated AT devices such as artificial limbs is not available (ATU_NP_2). Even a change of hearing aid battery is costly and*	*AT centres often provide training in how to use the devices, such as how to walk using crutches after straightening the leg with an operation (ATSU_BD_3).* *Repair and maintenance is a problem (ATSU_BD_3).*	*Often repair and maintenance is referred to the DDRC, but there is a lack of the right professionals both at the DDRC and community level and there is no systematic mechanism for repair and maintenance (ATPM_IN_1, 2). So, while in principle there is provision of repair, maintenance and*

(*continued*)

Table 2. Continued.

Process	Nepal	Bangladesh	Bangalore, India
	challenging for a user (ATU_NP_5). *AT users are often not trained in proper use, and are not even aware about malpractices, such as sometimes wheelchair users take a bath sitting on the wheelchair (ATU_NP_4).* *However, some respondents reported that sometimes AT centres provide repair and maintenance training to the users and their families for basic repair and maintenance locally (ATSP_NP_1, 2, 3, 4).* *AT equipment frequently falls out of use due to a lack of maintenance and repair. Getting a hearing aid repaired or replaced is a challenge and once broken it has no value (ATU_NP_1). Due to lack of training in proper repair and maintenance, even wheelchairs often become unusable within a year (ASTP_NP_8). Even where AT devices are repairable, they must be taken to the AT centres, which are only available in urban centres (ATSP_NP_, 4, 7).*	*The cost of repair and maintenance prohibits people opting for the timely repair and maintenance of equipment (ATSU_BD_6) – although sometimes staff of AT centres who are AT users themselves get support with repair and maintenance (ATSU_BD_7, 6).*	*replacement of AT solutions at the DDRC (ATSP_IN_4), in reality those rarely exist (ATSP_IN_6).* *Some AT centres have their own repair and maintenance centres – and sometimes even a branch set up in rural areas (ATSP_IN_8) – but often there is no follow up mechanism in place (ATSP_IN_2, 9).* *AT service providers often try to shift the responsibility for repair, maintenance and management to AT users and their families (ATSP_IN_9). Users of more complex AT suffer the most and some even die because of immobility, bed sores, UTI etc (ATSP_IN_2).* *Sometimes local workshops can repair AT devices (ATSU_IN_3).*

each step of the 7-step HEART process framework in the subsequent headings below:

Initiative

It is common in Bangladesh, India and Nepal that the first contact of prospective AT users with an AT service provider is through family, peer groups, the health system or education system. Attending a health facility or a camp is the most common route to initial assessment of disability and referral to the higher-level centres for AT services in all three countries. Most of these assessment opportunities and AT centres are in urban areas. However, there is a trend towards more regular camps in rural areas and incorporation of AT-related services in mainstream health facilities in India and Nepal, but less so in Bangladesh. Lack of awareness among family members is one of the biggest hurdles for prospective AT users to getting assessed in all these countries. The DDRC approach practiced in the study area Bangalore has a good system of identification of prospective AT users through their village rehabilitation workers. There are opportunities to explore whether a similar approach could be adopted in Nepal and Bangladesh, and in other parts of India.

Assessment

Currently there is no systematic AT needs assessment system at the community or facility level in Nepal or Bangladesh, but Bangalore, India has such a system through their DDRC where rehabilitation professionals are employed. In Nepal and Bangladesh, needs assessments are conducted when prospective AT users are referred to AT centres by their peers, health system, education system or through screening camps. Shortage of appropriate professionals makes it difficult to conduct proper assessments in all three countries, which sometimes leads to inappropriate AT selection. In the case of Bangalore, the preliminary assessments take place in the DDRC where basic AT solutions are provided. Since these DDRCs are attached to health facilities, they can take care of both medical and AT related assessments.

A dedicated AT service delivery structure similar to that practiced in Bangalore (i.e., a DDRC that is relatively easily accessible for people and that does a systematic assessment) is a good practice which is currently lacking in both Bangladesh and Nepal – and in India only 262 out of 741 districts have a dedicated system through DDRCs. Ideally, all three countries could learn how this system works and adapt it to suit their context.

Selection of the assistive solution

The systematic assessment and selection of assistive solutions, such as whether someone needs a wheelchair or walking aid, takes place when prospective AT users arrive at the DDRC in the case of Bangalore, India, and AT centres in the case of Nepal and Bangladesh. Some specialist hospitals in all three countries also have such facilities and professionals to assess and select AT devices. Selection of AT devices sometimes takes place in camps too. Other countries and other parts of India can learn from DDRC practices in Bangalore: because DDRCs offer a complete package of services, in principle more people have access to more services locally (within their district). Establishment of a similar dedicated structure attached to the existing district health system would improve the AT service delivery system in each country.

Selection of the equipment

It is common in all three countries that AT devices such as wheelchairs, walking sticks, crutches, walkers and hearing aids are

standard equipment purchased by government, users themselves, or other service providers. Complex AT equipment which cannot be used without personalization (such as specialized wheelchairs, orthosis, or prothesis) should be purchased or provided with proper professional assessments, selection and personalization. These advanced facilities are available only in some dedicated AT centres or hospitals but not in general hospitals, district hospitals or local health facilities. Some personalized equipment such as orthosis and prothesis are fabricated and provided to AT users at the DDRC in Bangalore, but no such dedicated centres are available in Nepal and Bangladesh, and they are lacking in many other parts of India. Most equipment is selected by AT professionals either at AT centres or some specialized hospitals in all three countries. More systematic selection of appropriate equipment for AT users in all three countries could significantly enhance the benefit that AT users get from the equipment.

Authorization

Obtaining funding for AT services is the most challenging and complex of the seven steps for PWDs in all three countries. All three countries have three sources of funding people use to get AT services: out of pocket funding, Government funding, and charity sector funding. In both India and Nepal, government ring-fences a certain percentage of their annual budget for the benefit of PWDs, whereas in Bangladesh the Government allocates some budget through the Ministry of Social Welfare, but this is not as systematic as in the other two countries. Charity sector funding is very limited in all three countries, but in the case of Bangladesh it is the major source of funding. Everybody interviewed said that it is the responsibility of the respective Government to provide AT, but in practice most users have to pay out of pocket for it. In all cases the process of getting Government or NGO support involves multiple steps from applications and recommendations to the final approval. Often those people who need the service most, such as poor people from rural areas and people with complex/multiple disabilities, have lower chances of accessing Government funding. They often rely on charity, family or out of pocket expenses for their AT solutions.

The dedicated annual budg*et al*location system for PWDs in India and Nepal at least provides some guarantee of regular funding for AT solutions in these countries, which could be adopted in Bangladesh to increase the access to AT solutions for PWDs.

Implementation

It is common in all three countries that when AT users purchase their devices out of pocket, all of the above seven steps swiftly take place as one event. For example, a prospective user visits a private shop or AT centre, tries the devices there, and if they can afford it and it fits, they buy it and start using it. Similarly, when standard AT devices such as wheelchairs, crutches, walkers, sticks and hearing aids are distributed, they generally take whatever is provided to them rather than trying, fitting or testing other alternatives. Generally, in all three countries, any training or orientation provided at the time of handing over the AT equipment is minimal. Even in complex cases such as a wheelchair for a person with cerebral palsy, protheses, orthoses and other personalized equipment, proper assessment, measurement, fitting and user training are also limited.

The implementation of AT solutions depends upon the type and complexity of the AT equipment. For simple devices most of the seven steps are taken quickly. For complex and advanced devices, especially personalized equipment, this often takes place in different places and it can take a long time to move from one step to another. Implementation of personalized and complex devices takes place in AT centres in all three countries, DDRCs in the case of Bangalore, and at some specialist hospitals. All three countries could benefit if they follow a more user-focussed personalized AT service delivery approach available from district health facilities.

Management and follow-up

Lack of follow up, repair and maintenance of AT equipment is common in all three countries. There is no practice of making an individual follow-up plan. Once devices are delivered, it is the responsibility of users to maintain the equipment. Sometimes service providers provide basic repair and maintenance of the equipment, and a basic toolkit as appropriate, but there is no follow-up or management plan. This leads to quick wear and tear on the equipment, underuse, malfunction, and sometimes can even be detrimental to the user's health. Even when repair is possible, there is no provision of funding from Government or charities, leaving AT users themselves to bear the repair cost out of their own pocket. Even if repair services are available, users have to travel to the AT centres which in itself can be very challenging. All these factors in combination hinder AT users in ensuring proper repair and maintenance of their equipment.

One of the modalities practiced both in India and Bangladesh which seems to work was the use of local materials in the production of AT equipment such as bicycle parts in wheelchairs, sticks, and crutches; and the use of mobile phone parts in hearing aids. In addition, there are some examples of training local artisans in repair and maintenance of AT equipment. Nepal can learn from this approach and it would benefit prospective AT users if this is promoted and practiced widely in all three countries.

Discussion

In systematically analysing AT service delivery through the seven process steps, this study shows that AT service delivery processes in Bangladesh and Nepal are very fragmented (i.e., most of the steps are blurred or missing) while in Bangalore there is a clearer pathway for prospective users through the seven steps, even if the reality does not always match up to the theory (for example, in relation to ongoing repair and maintenance). In all three countries (albeit to a lesser extent in Bangalore), we identified particular problems related to human resources, geographical coverage, and funding, which inhibit movement of prospective AT users through the process stages of service delivery, and in management and follow-up once users have been provided with devices.

Human resource constraints were a common explanation for failures at various steps of the process. Unlike better developed European AT service delivery modalities which are often equipped with physicians or physiatrists, occupational therapists, physiotherapists, and orthopaedic practitioners, prospective AT service users in Bangladesh, India and Nepal often come into contact with the AT service delivery system through the mainstream health and education sector – this is often *ad hoc* and may not identify all PWDs who could benefit from AT. Therefore, integration of the AT service delivery system with health and education systems will help to close the current system gaps in relation to the early process steps in these countries. For this purpose, training of grassroots-level community health workers and primary school teachers in basic disability identification skills, such as the

use of Washington Group tools and referral to health facilities for further assessment and referrals, might help to improve the systems.

Assessment and selection of assistive devices and selection of the specific equipment often takes place at a designated AT delivery centre, at a hospital, or at the health and AT service camps in each country. The urban-centric nature of AT service provision is a common challenge prospective AT user in rural areas face in Bangladesh, India and Nepal, creating a need to make costly and difficult journeys to urban areas to seek services. The increasing use of camps is alleviating this to some degree – and further use of such outreach activities could improve the situation further.

The dedicated annual funding provision for the benefit of PWDs in India and Nepal is a good way forward, which the Government of Bangladesh could also introduce. Even where a dedicated budget is available, however, it is insufficient and it can still be difficult for prospective AT users to access funding. A lack of ability to access the authorities who sanction or sign off the final approval, and the need to provide documentation that not all PWDs have, is often an insurmountable obstacle for prospective AT users, especially if they need to follow multiple steps of recommendation and approval (e.g., a recommendation letter from the local authority, local medical professional, local AT professional, and final approval from the higher authority). These complex approval systems limit access to AT services. Similarly, divided responsibilities among ministries such as Ministry of Health and Ministry of Social Welfare in all three countries often creates confusion among policy makers, service providers and the users of the services.

Although it has its own weaknesses in practice, the prospective AT service user identification through VRW (Village Rehabilitation Worker) at the community level and DDRC attached to the health system in the study area in Bangalore seems a viable AT service delivery process which both Nepal and Bangladesh, and other parts of India, can learn from and develop for their local context. Similarly, use of local materials to produce AT equipment and training of local artisans to repair such equipment, as practiced in India and Bangladesh, is something Nepal can follow if applicable in their local context.

Follow-up after the provision of devices was found to be critically weak in all three countries – either with no system at all (as in Bangladesh and Nepal), or one that functions inconsistently in practice (as in Bangalore). This lack of follow-up detrimentally affects the experience of AT users and shortens the useful lifespan of equipment. Of the seven steps, this is the one that was most consistently found to be weak across all three countries.

In short, we found that AT service delivery processes – as experienced by users, and as perceived by service providers and policymakers – are suboptimal in relation to multiple steps in each of the three countries, and therefore need improvement.

Limitations

Only PWDs with mobility and hearing related disabilities were included in this study. Therefore, even though the findings from this study might apply to PWDs with other disabilities, they cannot be directly applied to other groups of PWDs. The study areas were Kathmandu and Lalitpur districts of Nepal, Bangalore in India, and Dhaka in Bangladesh. Therefore, the findings from this study apply to these areas only. This is a particular issue in the India case, where different systems exist in different states. However, the findings from this study are likely to be relevant to other areas of above countries and other developing countries.

Furthermore, we experienced that a common limitation of the use of HEART 7 step model to use in examining the AT service delivery process in Nepal, India and Bangladesh is that often these steps are not seen as separate, confusing the service delivery process. For example, when a prospective AT user visits a service provider often the steps ii to iv and vi (i.e., assessment, selection of the assistive solution, selection of the equipment and implementation) merges and takes place at the same time, especially in case of relatively simpler AT solutions. Similarly, in the context of Nepal, India and Bangladesh the word authorization mainly meant the approval of funding for a particular AT service, which could be easily replaced by a phrase "Approval for funding", rather than a term authorization.

Conclusion and recommendations

We recommend that all three countries systematically assess practice against the process model used in this study [2,11], as well as a quality framework [27] (which was beyond the scope of this article), and learn from each other. Although the system we examined in Bangalore was by far the most coherent, all three countries can learn from the best practices found elsewhere.

- Extending opportunities for training of community-level health and education workers could help alleviate the human resources deficiencies in all three countries.
- Greater use of outreach camps and other models of service provision in rural areas could address the urban-centric nature of the systems we found in all three countries.
- The regular allocation of funding in India and Nepal could be adopted by Bangladesh. We also recommend that all required authorization and approval for funding and AT solutions at the users' level should be provided from a single channel or single point so that the prospective users do not need to go from place to place for these approvals.
- To improve follow-up and maintenance opportunities, the use of locally available materials to produce AT devices and training of local artisans to repair and maintain them that we found in India and Bangladesh can be adapted and extended in all three countries and beyond.

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