

Universidade de São Paulo  
Faculdade de Saúde Pública

Saúde Global e Direito a Tecnologias Essenciais:  
o Caso do Acesso à Tecnologia Assistiva

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Tese apresentada ao Programa de Pós-Graduação em Saúde Global e Sustentabilidade para obtenção do título de Doutor em Ciências.

Área de concentração: Políticas, sistemas e instituições internacionais de saúde global e ambiente sustentável.

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## RESUMO

RAMOS, VD. **Saúde Global e Direito a Tecnologias Essenciais: o Caso do Acesso à Tecnologia Assistiva.** 2021. Tese (Doutorado em Saúde Global e Sustentabilidade). São Paulo: Universidade de São Paulo, Faculdade de Saúde Pública; 2021.

**Introdução:** O acesso à tecnologia assistiva é tanto “mediador” quanto “moderador” de outras mudanças sociais para a equiparação de oportunidades e a promoção da justiça, o que inclui o direito à saúde e à participação social plena. O objetivo da tese é consolidar um conjunto de achados sobre os resultados obtidos pela política brasileira de provisão de tecnologia assistiva nos últimos anos e oferecer uma análise inédita, ainda que inicial, sobre o comércio internacional de produtos assistivos. **Material e Métodos:** A tese apresenta uma coletânea de três artigos (um deles inédito) que investigam diferentes aspectos da provisão e do acesso à tecnologia assistiva em nível subnacional, nacional e internacional, assim como distintos componentes de políticas, sistemas, serviços e produtos assistivos, incluindo análises quantitativas de bancos de dados públicos nacionais e internacionais, e estudos clínicos sobre o impacto da tecnologia assistiva. **Resultados:** Os artigos demonstram como o abandono de produtos assistivos em São Paulo se assemelha ao de outras localidades e oferece detalhes adicionais sobre os fatores que o influenciam; que será preciso manter o desempenho dos últimos anos e ainda corrigir desigualdades internas para que as metas do atual Plano Nacional de Saúde sobre a provisão de tecnologia assistiva sejam atingidas; e que há espaço para negociações internacionais que busquem maior previsibilidade e redução de tarifas, assim como a desconcentração de mercados no comércio internacional de produtos assistivos. **Conclusões:** O acesso à tecnologia assistiva, como uma estratégia valiosa para a busca da equidade no âmbito da saúde global, deve ser compreendido como instrumento e catalisador para a consecução de metas como os Objetivos de Desenvolvimento Sustentável e de outras mudanças sociais que incluem o direito à saúde e à participação social.

**Palavras-chave:** Tecnologia Assistiva, Acesso, Provisão, Saúde Global, Tecnologias Essenciais.

## ABSTRACT

RAMOS, VD. **Global Health and the Right to Essential Technology: the case of Access to Assistive Technology**. 2021. Tese (Doutorado em Saúde Global e Sustentabilidade). São Paulo: Universidade de São Paulo, Faculdade de Saúde Pública; 2021.

**Introduction:** Access to assistive technology is both a “mediator” and a “moderator” of other social changes for the equalization of opportunities and the promotion of justice, which includes the right to health and full social participation. The objective of the thesis is to consolidate a set of findings on the results obtained by the Brazilian policy on the provision of assistive technology in recent years and to offer an original, albeit initial, analysis of international trade in assistive products. **Material and Methods:** The thesis presents a collection of three articles (one of them unpublished) that investigate different aspects of the provision and access to assistive technology at a subnational, national, and international level, as well as different components of assistive technology policies, systems, services, and products, including quantitative analyzes of national and international public databases and clinical studies on the impact of assistive technology. **Results:** The articles demonstrate how the abandonment of assistive products in São Paulo is similar to that in other settings and provide additional details on the factors influencing it; that it will be necessary to maintain the performance of recent years and also to correct internal inequalities so that the goals of the current National Health Plan on the provision of assistive technology are achieved; and that there is room for international negotiations that seek greater predictability and reduction of tariffs, as well as the deconcentration of markets in the international trade of assistive products. **Conclusions:** Access to assistive technology, a valuable strategy towards global health equity, should be understood as both a means and an end to fulfilling the Sustainable Development Goals and other social changes that include the right to health and full social participation.

**Keywords:** Assistive Technology, Access, Provision, Global Health, Essential Technology.

## LISTA DE SIGLAS

AP. *Assistive Product*

AT. *Assistive Technology*

CARF. *Commission on Accreditation of Rehabilitation Facilities*

CI. *Confidence Interval*

COVID-19. *Coronavirus Disease-2019*

CRPD. *Convention on the Rights of Persons with Disabilities*

GREAT. *Global Research, Innovation, and Education in Assistive Technology Summit*

HCFMUSP. *Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo*

HIS. *Health Information System*

HS. *Harmonized System*

IMREA. *Instituto de Medicina Física e Reabilitação*

ISO. *International Standards Organization*

ITC. *International Trade Centre*

KAFO. *Knee-Ankle-Foot Orthosis*

LMIC. *Low- and Middle-Income Country*

MFN. *Most Favored Nation*

NHP. *National Health Plan*

NHS. *National Health Survey*

OMS. *Organização Mundial da Saúde*

OPAS. *Organização Pan Americana da Saúde*

PSD. *Postural Support Device*

SUS. *Sistema Único de Saúde*

UN Comtrade. *United Nations International Trade Statistics Database*

USD. *United States Dollars*

WCO. *World Customs Organization*

WHO. *World Health Organization*

WTO. *World Trade Organization*

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## APRESENTAÇÃO

Além da oportunidade de cursar as disciplinas e me dedicar ao meu próprio projeto acadêmico, o período em que integrei o Programa de Pós-Graduação em Saúde Global e Sustentabilidade foi especialmente valioso em razão dos demais projetos de pesquisa de que pude fazer parte e do contato que tive com outros grupos de pesquisa atuando em temas afins ao meu próprio e nos quais são referência.

Assim, as três publicações selecionadas para esta coletânea refletem apenas uma parte dos esforços de pesquisa neste tema envidados ao longo dos últimos anos.

Outros projetos iniciados no período ainda não foram concluídos ou resultaram em publicações que pudessem ser incluídas nessa coletânea. Entre eles, destacam-se as revisões sistemáticas da literatura sobre os métodos utilizados e os resultados obtidos na estimativa da oferta e da demanda por tecnologia assistiva, realizadas em cooperação com pesquisadores na *University College London*, *London School of Hygiene and Tropical Medicine*, e *Maynooth University*. Esse projeto, inicialmente elaborado em resposta a uma chamada do Comitê Editorial responsável pelo Relatório Global sobre Tecnologia Assistiva, está baseado nos resultados iniciais apresentados no artigo *"Measuring met and unmet assistive technology needs at the national level: Comparing national database collection tools across eight case countries"* (1), para o qual também contribuí.

Hoje faço parte da equipe responsável pelo projeto *"Avaliação Rápida da Necessidade, Demanda, Oferta e Satisfação do Usuário de Tecnologia Assistiva entre Pessoas em Reabilitação em São Paulo, Brasil"*, um estudo transversal, de base populacional, sobre a prevalência da necessidade, acesso e uso de produtos assistivos entre pessoas em tratamento ambulatorial e especializado de reabilitação nas unidades do Sistema Único de Saúde no município de São Paulo, concluído ainda no primeiro semestre de 2021, por meio de entrevistas estruturadas com base no questionário padronizado da Avaliação Rápida de Tecnologia Assistiva da Organização Mundial da Saúde (OMS), para o qual contribuí ativamente na sua concepção e posterior tradução para a Língua Portuguesa.

Em outras iniciativas, a provisão de tecnologia assistiva é apenas um dos aspectos da investigação sobre a assistência integral em saúde para pessoas com deficiência, tais como os projetos "*Análise da Implementação da Rede de Cuidados à Pessoa com Deficiência: Disponibilidade de Recursos, Integralidade do Cuidado e Avaliação dos Resultados*" e "*Fortalecendo a Inclusão de Pessoas com Deficiência no Sistema de Saúde no Brasil*", que usam uma variedade de abordagens para investigar o acesso e a qualidade do cuidado recebido por essa população por meio de parcerias científicas nacionais e internacionais.

Ao longo desse período, fiz parte do processo de elaboração da Agenda global de pesquisa prioritária para melhorar o acesso à tecnologia assistiva (2), assim como das comissões organizadoras de duas conferências capitaneadas pela OMS, a Conferência Global sobre Pesquisa, Inovação e Educação em Tecnologia Assistiva (3), em 2017, e a Consulta sobre o Relatório Global sobre Tecnologia Assistiva, em 2019 (4).

Nessas três oportunidades, assim como em outras, proporcionadas por minha participação no Centro Colaborador da OPAS/OMS para Reabilitação, sediado no Instituto de Medicina Física e Reabilitação do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, pude conhecer de perto os rumos da pesquisa e das políticas públicas sobre o tema a partir de relatos dos mais diversos grupos e do meu próprio engajamento na condução dos trabalhos.

Além disso, tive a chance de desenvolver uma concepção mais crítica sobre a cooperação internacional em saúde, quer seja pela realização de um estágio junto à unidade de Acesso à Tecnologia Assistiva e Dispositivos Médicos, da divisão de Acesso a Medicamentos e Produtos de Saúde, na sede da OMS, ou pela participação na Aliança Latino Americana pela Tecnologia Assistiva, uma comunidade que valoriza a experiência local na incorporação das produções normativas internacionais sobre o acesso à tecnologia assistiva (5).

## INTRODUÇÃO

Uma questão de saúde global é aquela que está relacionada às dinâmicas, estruturas e relações políticas no plano internacional que tem impacto não só na exposição e na vulnerabilidade à doença e a piores desfechos de saúde (ou seja, sobre a incidência, a prevalência e os desfechos vividos pelos grupos sociais particularmente afetados), mas também na capacidade de reação e resposta, incluindo a disponibilidade de recursos e a capacidade de mobilizá-los de forma eficaz (6). Atualmente, o campo da saúde global compreende um diversificado leque de atores, com agendas muito variadas e recursos financeiros e tecnológicos sem precedentes, porém distribuídos de maneira assimétrica (7).

É nesse contexto desafiante à garantia da equidade e da justiça social que esforços nacionais e internacionais devem ser articulados para que se busque assegurar o mais amplo acesso às tecnologias essenciais e, dentre elas, à tecnologia assistiva. Internacionalmente, a importância da tecnologia assistiva como um meio para a equiparação de oportunidades já foi destacada em diferentes momentos, inclusive por instrumentos relativos aos direitos humanos das pessoas com deficiência, idosos e pessoas com condições crônicas de saúde (8-11). No entanto, apesar de seu evidente potencial e dos compromissos assumidos internacionalmente, é preciso reconhecer as patentes limitações à sua ampla disseminação e uso por quem dela mais se beneficiaria (12).

No âmbito da saúde global, pode-se destacar o papel a ser desempenhado pela tecnologia assistiva evidenciando-a como uma estratégia valiosa para a busca da equidade. Reconhecendo-se a interface entre a promoção da equidade e da sustentabilidade, tão caras à saúde global como disciplina que investiga e investe na valorização da ética e da justiça social (13), a tecnologia assistiva, como um subconjunto das tecnologias de saúde que abrange todos os conhecimentos organizados e habilidades relacionadas a produtos assistivos, incluindo sistemas e serviços, em todos os domínios funcionais (mobilidade, audição, visão, cognição, comunicação, autocuidado, entre outros); e os produtos assistivos em si, definidos como qualquer produto externo (incluindo dispositivos, equipamentos, instrumentos ou softwares), especialmente produzido ou amplamente disponível, cujo propósito primário é manter ou melhorar a funcionalidade e a independência individuais, além de prevenir a

deficiência e condições secundárias de saúde, e assim promover o bem-estar (14); desempenham um papel tanto “mediador” quanto “moderador”, à medida que podem ser o próprio instrumento para a consecução de metas como os Objetivos de Desenvolvimento Sustentável ou funcionar como um catalisador para atingi-los. Assim, ao “mediar” esse processo, a tecnologia assistiva é parte integrante da intervenção que propicia a mudança social; por outro lado, sua provisão também pode “moderar”, ou facilitar, a mudança social em outras áreas, propiciando maior alcance e relevância aos resultados produzidos (15).

Merecedores de especial atenção, os produtos assistivos prioritários são aqueles considerados altamente necessários, que por serem uma necessidade absoluta para manter ou melhorar a funcionalidade individual precisam estar disponíveis a um custo que a comunidade ou o Estado podem pagar (14).

De modo geral, a tecnologia assistiva tem destaque como uma intervenção no nível ambiental que busca superar as barreiras existentes à realização de atividades e à participação plena de pessoas com diversas condições de saúde e deficiências (*impairments*) em suas estruturas corporais e funções fisiológicas, e assim evitar os aspectos negativos da interação entre esses indivíduos e o ambiente em que vivem (16). Ao evitá-los, a tecnologia assistiva tem o potencial de prevenir a incapacidade (*disability*) e promover a funcionalidade das pessoas e, em nível populacional, das suas comunidades. É nesse sentido que o acesso à tecnologia assistiva é tanto “mediador” quanto “moderador” de outras mudanças sociais para a equiparação de oportunidades e a promoção da justiça, o que inclui o direito à saúde e a participação social plena (17,18) de mais de dois bilhões de pessoas até 2050, segundo estimativas consideradas conservadoras (12,19).

Nesses aspectos, essa proposta se aproxima da “abordagem das capacidades” e em especial das interpretações de Martha Nussbaum e Sridar Venkatapuram para essa “teoria parcial da justiça” (5).

Ao reconhecer a diversidade real dos seres humanos, Nussbaum baseia sua proposta de igualdade na dignidade humana e no respeito devido a ela e às necessidades que pessoas diferentes tem para exercer um mesmo conjunto de funcionalidades humanas. Quando apresenta essa proposta, Nussbaum estabelece que o respeito à dignidade humana demanda um conjunto de direitos básicos às condições sociais para uma sociedade justa, e que as falhas e

privações resultantes de arranjos sociais injustos que impedem que todos sejam suficientemente capazes evidenciam iniquidades no interesse e na preocupação demonstradas pelas sociedades e na proteção da dignidade de grupos e indivíduos que as integram (20).

Ao negar as condições sociais para a prestação dos cuidados necessários, entendidos como um direito social primário nos termos expostos acima, as sociedades injustas constituem ambientes desproporcionalmente restritivos para alguns indivíduos, impondo-lhes uma vulnerabilidade incomum pela dependência indesejada de terceiros (20).

Venkatapuram, em suas proposições sobre a “abordagem das capacidades”, destaca a capacidade de ser saudável como central para esse conjunto de capacidades que constituem o cerne da funcionalidade e da dignidade humana, e reconhece a titularidade dos indivíduos às bases sociais para a própria existência dessas capacidades. Nesse sentido, o respeito à igual dignidade humana deve ser demonstrado por níveis iguais de interesse, preocupação e respeito ao se estabelecerem as instituições e os processos que produzem e distribuem as experiências e os desfechos de saúde observados em nível populacional (21).

Assim, nesses termos, a justiça da saúde e os arranjos sociais necessários para promovê-la estão além das políticas de cuidados em saúde e da prevenção e manejo das doenças somente, ocupando-se também da proteção, promoção e restauração das capacidades em níveis suficientes para alcançar a funcionalidade e a dignidade humana (21).

Ao observar o papel a ser desempenhado pela tecnologia assistiva como uma forma de cuidado e uma intervenção em nível ambiental para garantir a atenção às necessidades de quem dela se beneficiaria, e que por isso deve ser integrada aos arranjos sociais da sociedade, é que se propõe compreender a tecnologia assistiva como tecnologia essencial para uma justiça da saúde e uma justiça global.

Em função do papel da tecnologia assistiva de diminuir a brecha entre as funções individuais e a participação social, a defesa da sua promoção tem o potencial de gerar maior cooperação do que competição entre agendas internacionais diversas (22), como as relacionadas às condições crônicas de saúde e ao envelhecimento, mas também à educação inclusiva e ao trabalho

decente. Nesse sentido, a cooperação internacional se dá pela conjugação de esforços para a equiparação de oportunidades e a promoção da equidade.

Divisou-se esse potencial na investigação das reações dos Estados Membros e organizações da sociedade civil que declararam seu posicionamento sobre a resolução aprovada pela Assembleia Mundial da Saúde pelo aumento do acesso à tecnologia assistiva (20). Os declarantes não só destacaram a interseção entre a saúde, os direitos humanos e os Objetivos de Desenvolvimento Sustentável como um desfecho desejado por eles a partir do fortalecimento do acesso à tecnologia assistiva, como reiteraram o papel a ser desempenhado pela cooperação internacional para a sua consecução (22).

Em reconhecimento à variedade de arranjos que influenciam a saúde e a funcionalidade dos indivíduos, as publicações reunidas nessa coletânea e outras referenciadas aqui tem por objetivo demonstrar os resultados de diversos esforços de pesquisa, em áreas temáticas distintas e complementares, que tem por finalidade contribuir para o direcionamento das políticas públicas para soluções estruturais com impacto sobre a justiça social (13).

De modo geral, essas publicações são embasadas sobre um conjunto normativo e outro de evidências relativamente recentes, constituídos sobre o bojo de um novo esforço de governança global para melhorar os determinantes políticos globais do acesso efetivo à tecnologia assistiva. Por meio dessas iniciativas, busca-se sanar a iniquidade valendo-se de novos instrumentos normativos e evidências que reorganizam a atuação de atores nacionais e transnacionais com níveis de poder e interesses distintos para uma melhor distribuição de riscos e resultados de saúde e participação social (24).

A própria diferenciação entre produto e tecnologia assistiva já imprime uma perspectiva sistêmica a esse tema, reconhecendo os serviços e sistemas que precisam existir para que o acesso e o uso de produtos assistivos seja efetivo. Contudo, a provisão de tecnologia assistiva pode ser analisada como um sistema em si, e um sistema aberto e dependente do ambiente local, nacional e internacional em sua operação e produção de resultados (25). Dessa forma, não só as intervenções realizadas em diferentes componentes desse sistema afetam as demais, como mesmo intervenções em outros sistemas podem causar impactos sobre a provisão de tecnologia assistiva, evidenciando fatores que podem ser considerados seus determinantes em diferentes âmbitos.

Quando dá destaque à disparidade entre a prevalência da necessidade de produtos assistivos e do quanto essas necessidades são atendidas em todo o mundo, MacLachlan e colegas (26) também fazem referência às bases sociais e demográficas e às estruturas existentes que representam um risco real de negação de direitos e exclusão social para algumas parcelas da população. Nesse sentido, os autores elencam a tecnologia assistiva como um suporte necessário para a atenção às suas necessidades e aos seus direitos.

Com o objetivo de contribuir para políticas de tecnologia assistiva que sejam prioritárias e tenham condições de sustentabilidade para sua implementação, esses autores (26) apresentam uma proposta inicial sobre quais componentes devem estar presentes em iniciativas do gênero. Outro manuscrito (27), dessa mesma edição especial sobre os resultados da primeira Conferência Global sobre Pesquisa, Inovação e Educação em Tecnologia Assistiva (3), elenca um conjunto de princípios e critérios considerados necessários para sistemas e serviços de provisão de tecnologia assistiva eficientes e efetivos.

Ambas as publicações abordam questões de pesquisa que buscam melhorar o acesso à tecnologia assistiva e que redundaram de uma estratégia coordenada para a criação de uma agenda de pesquisa prioritária sobre o tema, que visa a orientar a produção de resultados relevantes em áreas chave para a redução das necessidades não atendidas por tecnologia assistiva (2).

Ademais, o esforço de pesquisa em tecnologia assistiva tem tanto o objetivo de fortalecer os sistemas de provisão de produtos assistivos e serviços relacionados pela ação sobre as falhas de seus componentes, quanto de elevar seu nível de prioridade entre os temas de saúde global, valendo-se dos compromissos assumidos pela comunidade internacional e orientando a ação sobre determinantes setoriais de âmbito global (12).

Enfim, a tese aqui defendida é de que o acesso à tecnologia assistiva é uma estratégia valiosa para a busca da equidade no âmbito da saúde global, e que deve ser enfocada sob o prisma da sustentabilidade e da justiça social, como “mediadora” e “moderadora”, ou seja, instrumento e catalisador para a consecução de metas como os Objetivos de Desenvolvimento Sustentável e de outras mudanças sociais que incluem o direito à saúde e a participação social plena. Assim, a contribuição original desta tese para o campo é consolidar um conjunto de achados sobre os resultados obtidos pela política brasileira de

provisão de tecnologia assistiva nos últimos anos e oferecer uma análise inédita, ainda que inicial, sobre o comércio internacional de produtos assistivos, demonstrando que há espaço para negociações internacionais que busquem maior previsibilidade e redução de tarifas, assim como a desconcentração de mercados.

Se, por um lado, outras políticas nacionais direcionadas à garantia do acesso a tecnologias essenciais de saúde, como vacinas e medicamentos, servem de exemplo sobre o potencial positivo da formulação de processos que favoreçam a melhor regulação, a maior disponibilidade e a facilitação do acesso, elas também demonstram o alcance limitado e os desfechos frequentemente desiguais que elas produzem, assim como sua fragilidade frente a mudanças no contexto demográfico, sanitário, social, econômico ou político; daí a necessidade de se investigar e promover o diálogo social, participativo e inclusivo, baseado no direito à saúde e na experiência brasileira de fortalecimento da cobertura universal de saúde (28).

Por apresentar-se na forma de uma coletânea de artigos, cada publicação e manuscrito apresenta em detalhes a metodologia empregada e os resultados obtidos, assim como suas limitações e novas oportunidades de pesquisa identificadas. No entanto, a tese como um todo possui suas próprias limitações.

O acesso à tecnologia assistiva é um objeto de limites imensuráveis e a própria opção por uma coletânea de artigos tem por objetivo demonstrar a necessidade de se estabelecer recortes claros na definição de cada aspecto a ser investigado. Da mesma forma, essa opção busca propiciar o emprego de metodologias complementares, mas seus resultados individuais são notadamente apenas parciais.

A política brasileira de provisão de tecnologia assistiva, a capacidade do SUS de atender as necessidades da população e os resultados obtidos por ela merecem uma investigação abrangente, sistemática e detalhada, comparável a de outros contextos nacionais. Esforços nesse sentido devem ser envidados com vistas à construção de uma base de evidências que propicie seu monitoramento e avaliação contínuos, para que a falta de dados, nacional e internacionalmente, não se constitua em mais uma barreira ao acesso à tecnologia assistiva (29).



## APRESENTAÇÃO DA COLETÂNEA DE ARTIGOS

Um aspecto de grande relevância, que perpassa diversas das áreas temáticas prioritárias de pesquisa em tecnologia assistiva e que está diretamente relacionado às políticas, sistemas e serviços para a sua provisão eficiente e efetiva, é o abandono de produtos assistivos. Por ser um evento tão sintomático das condições e dos desfechos obtidos pelos recursos disponíveis para a provisão de tecnologia assistiva, e que possui paralelos em países com políticas, sistemas e serviços diversos, é que o artigo *“Abandonment of assistive products: assessing abandonment levels and factors that impact on it”* (30), laureado pela Sociedade Brasileira de Engenharia Biomédica com o prêmio *“SBEB-Boston Scientific de Inovação em Engenharia Biomédica para o SUS 2020”* na categoria *“Trabalho Científico Publicado de Avaliação Pós-Incorporação”*, foi incluído nessa coletânea.

Abrangendo desde aspectos clínicos sobre o impacto individual do acesso a produtos assistivos mais ou menos adequados até as limitações dos sistemas de provisão em oferecer produtos apropriados de maneira sustentável, passando pelos modelos de serviço possíveis de serem implementados, o artigo destaca quais fatores são mais relevantes para o abandono de produtos assistivos, uma barreira significativa para a assistência integral a todas as pessoas que poderiam se beneficiar deles.

A segunda publicação inclusa nessa coletânea aborda outra faceta da provisão de tecnologia assistiva. Dentre os desafios do acesso à tecnologia assistiva identificados por uma recente síntese de evidências publicada pela Organização Mundial da Saúde (12), as características do comércio internacional são listadas como uma das suas principais limitações.

É por reconhecer no comércio internacional um dos mais relevantes determinantes globais do setor econômico de tecnologia assistiva que o artigo *“Assistive products’ international trade and tariffs”* (31) explora quantitativamente a concentração desse mercado e o tratamento tarifário adotado pelos países neste setor, dois aspectos significativos relacionados à sustentabilidade da oferta e da disponibilidade de produtos assistivos em muitos países.

Vale ressaltar que o artigo foi selecionado para apresentação oral em uma das sessões plenárias da Consulta sobre o Relatório Global sobre o Acesso à

Tecnologia Assistiva (4), realizado na sede da Organização Mundial da Saúde em 2019, e publicado na íntegra nos anais da conferência.

De modo a reconhecer o protagonismo histórico do Sistema Único de Saúde na assistência integral às pessoas com condições de saúde incapacitantes que se beneficiam do uso de produtos assistivos, o terceiro artigo (inédito) incorporado a essa coletânea é um estudo quantitativo, baseados nos dados públicos disponíveis nos sistemas nacionais de informação em saúde, sobre os desafios de se alcançar a equidade, em nível subnacional, da provisão de produtos assistivos no Brasil, um país onde o sistema de saúde incorporou desde muito cedo o acesso à tecnologia assistiva como um componente integrante da atenção integral à saúde.

Os três manuscritos (dois publicados e um ainda inédito, como se vê) selecionados para integrar essa coletânea apresentam o tema do acesso à tecnologia assistiva em diferentes níveis (local, no caso do abandono de produtos assistivos em uma população específica em São Paulo; nacional, no estudo sobre a redução das desigualdades regionais na provisão de tecnologia assistiva no Brasil; e, global, no que se refere ao comércio internacional nesse setor). Da mesma forma, essas três análises também ilustram aspectos distintos de políticas, sistemas, serviços e produtos assistivos, e desta forma utilizam metodologias e estratégias de análise distintas, incluindo desde análises quantitativas de bancos de dados públicos nacionais e internacionais a estudos clínicos sobre o impacto da tecnologia assistiva.

Além disso, esses três estudos também evidenciam o quanto a provisão de tecnologia assistiva é tanto um meio quanto um fim para a promoção da cobertura universal de saúde enquanto um dos Objetivos de Desenvolvimento Sustentável (22), ao passo em que investigam tanto aspectos relacionados à cobertura do sistema e dos serviços e produtos oferecidos quanto do acesso dos usuários aos produtos de que precisam, que lhes permitem ter condições de gozar de seus direitos.

Apesar da variedade de estratégias empregadas nessas investigações, todas valem-se de uma perspectiva comum, baseada nos direitos dessas populações à garantia da assistência integral e do acesso equitativo aos cuidados em saúde para uma participação social plena.

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ORIGINAL RESEARCH

## Abandonment of assistive products: assessing abandonment levels and factors that impact on it

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### ABSTRACT

**Purpose:** To investigate the levels and factors that influence the abandonment of assistive products by users of a local reference rehabilitation center.

**Methods:** This observational study involved users who received services and assistive products provided by our center of rehabilitation. Users were identified using the records of the center and their responses about the abandonment were collected through face-to-face interviews.

**Results:** The abandonment level of assistive products was 19.38%. 83.5% of the users use at least one of the assistive products they have received. Rigid and folding frame wheelchairs, with and without postural support devices, as well as shower wheelchairs, presented the lowest abandonment levels, followed by canes and lower limb orthoses. Upper limb orthoses, Knee Ankle Foot Orthosis(KAFO), walkers, crutches and lower and upper limb prostheses all presented higher abandonment levels.

**Conclusion:** The simultaneous use of multiple assistive products, users perception on the importance of using them, and completing the rehabilitation treatment were found to impact on the short and long-term use of products. The study offers inputs to decision making and planning for assistive technology provision in developing countries with regard to expected demand and service delivery.

### ARTICLE HISTORY

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### KEYWORDS

Assistive technology abandonment; assistive technology nonuse; assistive technology service delivery; assistive technology user satisfaction; access to assistive technology

### ► IMPLICATIONS FOR REHABILITATION

- Data about the abandonment of assistive products in Sao Paulo, Brazil, could assist informing decision making on provision and servicing of these products in similar settings.
- The strong correlation found between abandonment levels and the simultaneous use of multiple devices should be taken into account by health professionals when prescribing assistive products and providing guidance to users.
- The need for follow up on the use of assistive products after discharge from rehabilitation treatment becomes strikingly clear, as data show that completing treatment is significantly relevant when evaluating abandonment levels.
- As assistive products users' perception about the importance of using these devices is shown to be significant in explaining abandonment, it is mandatory that health and rehabilitation professionals take it into account when providing guidance and training users.

## Introduction

Only 5–15% of persons who need assistive products in low and middle income countries have access to one. However, the need is expected to grow as the prevalence of disability increases and population ageing (which is related to increased chances of using assistive devices) will probably make the use of assistive products even more common and widespread, requiring rehabilitation services and health systems attention [1,2].

The WHO [3] defines assistive technology as “a subset of health technology” and “the application of organized knowledge and skills related to assistive products, including systems and services”. Assistive products are “any external product (including devices, equipment, instruments or software), especially produced or generally available, whose primary purpose of is to maintain or

improve an individual's functioning and independence and thereby promote their well-being” and can also be used “to prevent impairments and secondary health conditions.”

According to the World Report on Disability [4], when assistive products are appropriate to and match their users needs and environment, they enhance user's independence and social participation. However, the opposite is also true. Difficulties in the interaction between users, their assistive products and user's environment could lead to the abandonment of assistive products.

Abandoning assistive products can be related to characteristics of the system and interventions carried out by health, rehabilitation and social support services in each country; to the physical and psychological characteristics of users and to particularities of their environment; or even to technical features and quality of

products. These factors could both be negative, such as worsening health conditions of the user, environmental barriers to the use of a product or the low quality of a given product or positive, such as improved health conditions, functional gains or enabling environments [5,6].

Assistive products abandoned for a negative reason might not only hinder user's rehabilitation and social inclusion, but also result in the waste of public resources. From the perspective of the healthcare system, not being able to recover assistive products that are provided and are no longer used results in a missed opportunity to save funds and resources. Thus, the economic leakage caused by the abandonment of assistive products results in "waste of resources, an unchanged situation in the person's disability and frustration for the users" [7].

Although persons with disabilities might need assistive technologies and products that improve social and community participation, there are still barriers to access and use and unmet needs [1,8]. The lack of access to assistive technology impacts functionality and influences social participation, a theme that has been discussed around the world [1].

The Physical and Rehabilitation Medicine Institute of the University of Sao Paulo Medical School General Hospital (IMREA-HCFMUSP) is a reference for secondary and tertiary levels of rehabilitation care for people with physical disabilities through the Brazilian Public Healthcare System in the State of Sao Paulo. In 2014, it was the first Brazilian institution to be accredited by the Commission on Accreditation of Rehabilitation Facilities (CARF) and is committed to improve the quality of services provided [9,10]. Hence, assessing the outcomes of the assistive products is important to improve the use of public resources.

Due to the importance of the abandonment levels of assistive products, as well as the lack of literature about the Brazilian context, the objective of this article is to show the levels and factors that influence the abandonment of assistive products by users of a local reference rehabilitation center.

## Materials and methods

This study has been approved by the Ethics Committee of the University of Sao Paulo Medical School General Hospital, as per registers 71602317.9.0000.0068.

It draws from the database of a survey contracted by the Sao Paulo State Secretariat for the Rights of the Person with Disability to assess the satisfaction of users with services received at IMREA-HCFMUSP. Telephone calls were followed by face-to-face interviews to collect information on users satisfaction with the services provided by the Institute, which included the provision of assistive products. Interviews represented no risk to its respondents.

Nine thousand hundred and four users were identified as having received some kind of rehabilitation services in at least one of the five facilities that comprise the Institute in the city of Sao Paulo, Brazil. Face-to-face interviews were scheduled with 1390 (15%) users, who agreed to participate.

As 35.2% of users gave up participating in the survey, 900 face-to-face interviews were carried out. Interviews were performed aiming at the participation of users themselves. However, due to communication impairments or legal restrictions (for those aged below 14 years), proxy interviews were attempted with caregivers and parents.

As the original questionnaire in Portuguese consisted of a number of questions on different aspects of rehabilitation service provision and social inclusion [11], a translated version of the questions referring to assistive products provision was also available.

Among other themes, respondents were questioned about the assistive products received, the use of assistive products, factors that influenced abandonment, difficulties in using assistive products and the importance users gave to using assistive products during their rehabilitation treatment.

About the design of the interview's questionnaire, it is important to highlight that it allows the identification, for each user, of what assistive products were provided and were still used. There were no specific considerations on the full- or partial-time use of these devices. Moreover, the survey did not apply a threshold between use and nonuse of assistive products, as it relies completely on user's perspectives.

When assessing the several reasons that can lead to abandonment, the questionnaire allowed different responses and open answers. For this study, however, answers were grouped together around four main categories, which are [12]:

- i. Personal factors:
  - a. User's health condition improved or worsened.
  - b. The user did not get adapted to the device or did not accept it.
  - c. The user was ashamed of using the device.
  - d. A new disease or injury prevented the use of the device.
  - e. The user lost or replaced the device.
- ii. Intervention-related factors:
  - a. The device was of inadequate size.
  - b. The device did not meet user's needs.
  - c. The device was inadequate to the intended functions.
  - d. The use was suspended by medical orders.
  - e. Using the device lead to discomfort or pain.
  - f. The user could not wear the device.
  - g. The user did not know how to use the device.
- iii. Product-related factors:
  - a. The device was worn out or broken.
  - b. The device was under maintenance.
- iv. Environmental factors:
  - a. The user felt discriminated when using the device.
  - b. The user faced barriers to using the device in or out of his/her home.

## Data analysis

Data are presented using descriptive statistics and comparisons on their respective independent proportions and odds ratios, which use confidence intervals(CI's) of 95%. In all cases, only results that showed a  $p < .05$  were deemed statistically different and significant.

This study allowed drawing the analysis on users that use only a part of the assistive products received, when it was necessary to adopt a clear threshold for use and nonuse (e.g., when calculating odds ratios), the threshold was established on the use of half of the products received, i.e, if a user uses up to half of the products he/she has received, this is scored as nonuse.

## Results

The analysis demonstrates that, from the 900 initial respondents, 643 (71.44%) of them have received some kind of assistive product. Thus, every research finding and results presented next relate to the characteristics and answers of this smaller group of respondents.

The average age of users is  $45.9 \pm 23$  years old, of which 376 (58.48%) are men and 267 (41.52%) are women. Among survey



**Table 1.** Number of assistive products provided, used or nonused, at the time of the interview.

Assistive products	Provided		Used		Nonused	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Cane	66	4.24	55	83.33	11	16.67
Crutch	35	2.25	24	68.57	11	31.43
Folding frame wheelchair with PSD	206	13.22	174	84.47	32	15.53
Folding frame wheelchair without PSD	97	6.23	81	83.51	16	16.49
Lower limb orthosis (KAFO)	91	5.84	67	73.63	24	26.37
Lower limb orthosis (others)	299	19.19	244	81.61	55	18.39
Lower limb prosthesis	62	3.98	41	66.13	21	33.87
Mobile/Tablet	1	0.06	0	0.00	1	100.00
Rigid frame wheelchair with PSD	81	5.20	75	92.59	6	7.41
Rigid frame wheelchair without PSD	30	1.93	27	90.00	3	10.00
Shower wheelchair	235	15.08	204	86.81	31	13.19
Upper limb orthosis	288	18.49	221	76.74	67	23.26
Upper limb prosthesis	15	0.96	7	46.67	8	53.33
Walker	52	3.34	36	69.23	16	30.77
Total	1558	100	1256	80.62	302	19.38

**Table 2.** Number of users who have received at least one assistive product, and the status of use or abandonment.

Quantity of products received	Number of users		Use all		Use a few		Use none	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Received 1	179	27.8	123	68.7	0	0.0	56	31.3
Received 2	173	26.9	127	73.4	21	12.1	25	14.5
Received 3	173	26.9	114	65.9	42	24.3	17	9.8
Received 4	81	12.6	63	77.8	12	14.8	6	7.4
Received 5	33	5.1	20	60.6	11	33.3	2	6.1
Received 6	3	0.5	2	66.7	1	33.3	0	0.0
Received 7	1	0.2	1	100.0	0	0.0	0	0.0
Total	643	100.00	450	70.0	87	13.5	106	16.5

respondents, 60.35% of them were users themselves, 32.5% were caregivers and 7.15% were parents or relatives.

Table 1 shows the number of assistive products provided by Instituto de Medicina Física e Reabilitação (IMREA-HCFMUSP) to these users and how many of them were still in use or were abandoned by the time of the interview. It is worth mentioning that each user might have received more than one assistive product according to his/her needs.

Considering the total number of users and the total number of assistive products provided, both used and nonused, it results that, on average, each user received 2.42 products, but only 1.95 were actually used at the time of the interview.

In general, on average, 19.38% of assistive products provided were abandoned. Nevertheless, it is important to highlight that the use of multiple devices can influence the use or abandonment of assistive products. Therefore, Table 2 presents the number of users per quantity of products received and how many of them used all, a few or none of the products received.

It is important to notice that Table 1 focus on products and how many of them were used or abandoned, while Table 2, on the other hand, focus on users and how many of them used all, a few or none of the products received.

Table 2 demonstrates that the majority of users (81.65%) received up to three devices.

The odds ratio on the use of assistive products comparing with those who have received only one product to those who have received more than one demonstrates that the first group has a smaller chance of use (0.36, CI: 0.24;0.54).

On the other hand, comparing the use of assistive products by users who have received three devices with those who have

received less or more devices (i.e, all others), demonstrates that the first group has more chances to use the assistive products provided (1.72, CI: 1.05;2.81)

Odds ratios calculated comparing users who have received all other quantities of products do not show statistically significant data. However, it is visible that chances to use increase for groups of users who received up to three products and then start diminishing for those who received four devices or more.

Table 3 shows the number of users who used or abandoned the assistive products they have received according to whether they were still on treatment or have completed it by the time of the interview.

The odds ratio calculated comparing users who were on treatment and those who have completed it demonstrated that the first group had more chances (2.25, CI: 1.48;3.42) to use the assistive products they have received.

The odds ratio comparing users that have completed rehabilitation treatment less than one year before the interview and those who have completed treatment for longer indicates that the first group had more chances (2.74, CI: 1.62;4.63) to use the assistive products they have received.

When comparing the group who have completed the rehabilitation treatment between one and three years before the interview and the rest of the users who have completed treatment, the odds ratio shows a smaller chance (0.80, IC: 0.48;1.33) of the first group to use the assistive products they have received.

Users who have completed rehabilitation treatment for more than three years before the interview, in comparison to other users who have completed treatment, have even smaller chances (0.24, IC: 0.12;0.46) to use the assistive products they have received.

Apart from short- and long-term use, which can be analyzed based on the use or abandonment of assistive products during or after completing rehabilitation treatment, the perception of the user about the use of assistive products during treatment is equally important when assessing their adherence to the use of assistive products. Table 4 shows the data of users according to their perception about the use and the actual use of assistive products at the time of the interview.

When comparing users that believe the use of assistive products during rehabilitation treatment is important or really important to those who believe the use is not important at all, is only a bit important or who are indifferent to it, the odds ratio shows that the first group had higher chances (3.84, IC: 1.69;8.73) to use

**Table 3.** Status of users according to whether they were still on treatment or have completed it at the time of the interview.

User status	Number of users	Use	Nonused
On treatment	309	270	39
Treatment completed	334	252	82
Treatment completed less than one year before the interview	167	141	26
Treatment completed between one and three years before the interview	125	91	34
Treatment completed for more than three years before the interview	42	20	22

**Table 4.** Perception of users about the importance of using assistive products during treatment.

Perception of users about the importance of use	<i>n</i>	%	Use	Nonused
Not important at all	3	0.47	12	12
A bit important	4	0.62		
Indifferent	17	2.64		
Important	147	22.86	491	128
Really important	472	73.41		

the assistive products they received, despite the significant difference between the sizes of each group.

Nevertheless, reasons to stop using an assistive product are not only personal such as individual perceptions on the importance of its use but could also be related to several other factors, as previously mentioned. Table 5 presents the main factors appointed by users for the abandonment of each category of assistive products, highlighting that users could indicate more than one reason to abandon the assistive products they have received.

In Table 5, reasons to abandon an assistive products are also divided between positive and negative factors, indicating that assistive products can be abandoned due to improving health and functioning conditions. When listing the factors that contributed to abandoning an assistive product, categories are listed in decreasing order.

## Discussion

Access to assistive technology and products is a human rights guarantee to which every signatory country of the United Nations Convention on the Rights of Persons with Disabilities, among which is Brazil, has committed. The Convention reiterates the importance of international cooperation to improve access to and the development of assistive technology. Thus, this study identifies the abandonment levels of assistive products and the factors that impact them among users of a local reference rehabilitation center in Sao Paulo, Brazil.

With reference to the users of assistive products, this study, as well as Federici et al. [5] demonstrates, a predominantly male population (58.48%). However, information on the prevalence of physical disabilities in Brazil, according to the 2010 National Census, shows that they are more prevalent among women (62.46% in Brazil and 63.46% in Sao Paulo) than among men [13]. This might imply that men have a privileged access to mobility-related assistive products, which may be related to their greater inclusion in the labor market and social inclusion in comparison to women in the same situation.

The study by Federici et al. [5] shows users with a higher average age ( $71.02 \pm 13.94$  years) when compared to this study ( $45.9 \pm 23$  years), which indicates a significant difference in the age profile of Brazilian users and a greater prevalence of physical disabilities among Brazilians aged 15 to 64 years of age, what is also shown in the last national census (especially for mild and moderate physical disabilities) [13].

The significant number of proxy respondents (39.65%) and specially caregivers (32.5%), might indicate that users also face barriers to communicate that have not been tackled by the provision of assistive products, as these are currently out of the scope of products and services offered by the Brazilian Public Healthcare System.

Abandonment, satisfaction, effectiveness and impacts of assistive products have also been assessed by Federici et al. [5] and others [14–17], who reiterate that there are no standard assessment tools to investigate the abandonment of assistive products. Several studies report that abandonment level are constantly around 30% [5,14,17,18]. A recent study performed telephone interviews with 749 Italian users of assistive products and demonstrated that 22.4% interrupted the use of their devices [5].

This study shows that 83.5% of users used at least one of the assistive products they have received, although only 70% of them actually used all of the products they have received. On the other hand, it also shows that 80.62% of the assistive products provided were been used at the time of the interview, an index that is similar to other studies [5,14,17,18].

Using these two different perspectives, one that focused on users and the other on the assistive devices provided to them, allows us to identify their complementarity. Although the usual focus, on the product, is informative, it is important to highlight that users need to receive special attention, once this is not a direct relation, specially when we consider the use of multiple devices.

When assessing the use of multiple devices, the major part (81.65%) of users receives up to three assistive products. Hence, this population requires a special attention by service managers, physicians and therapists who are involved in delivering services to assistive products users, mainly because of the alarming disparity in relation to their adherence to the use of assistive products.

A striking difference between the odds ratios on the use of assistive products of both groups (0.36 for those who received only one and 1.72 for those who received three) demonstrates that the profiles of these users can be remarkably different. Among those who received only one device, abandonment levels of shower wheelchairs (40%), folding frame wheelchairs with (35%) and without (33%) postural support devices (PSD) are meaningful. On the other hand, those who have received three assistive products have mostly abandoned upper limb prosthesis (67%) and crutches (50%). Abandonment levels for lower limb prostheses and walkers are high in both groups.

Moreover, the 1.99 average for assistive products provided by user and the 1.56 average use index (for those who received up to three devices) are significant and important when planning rehabilitation services and systems and the provision of assistive products in similar settings.

Reflecting the Brazilian context, where assistive products are often provided within rehabilitation treatment, this study demonstrates that there are remarkable differences between the use and abandonment levels of users who are still on rehabilitation treatment and those who have completed it. Completing rehabilitation treatment not only impacts abandonment, but also influences the

Table 5. Factors that impact on the abandonment of assistive products.

Products	Percentage of abandonment	Factors that influence abandonment	
Cane	16.67%	Positive	Personal: 50%
		Negative	Product: 33.3%
Crutch	31.43%	Positive	Intervention: 16,7%
		Negative	Personal: 16.7%
Folding frame wheelchair with PSD	15.53%	Positive	Personal: 33.3%
		Negative	Intervention: 33.3%
Folding frame wheelchair without PSD	16.49%	Positive	Personal: 33.3%
		Negative	Environmental: 11.1%
Lower limb orthosis (KAFO)	26.37%	Positive	Personal: 30.8%
		Negative	Product: 26.9%
Lower limb orthosis (others)	18.39%	Positive	Intervention: 26.8%
		Negative	Personal: 15.3%
Lower limb prosthesis	33.87%	Positive	Environmental: 3.8%
		Negative	Others: 7.7%
Rigid frame wheelchair with PSD	7.41%	Positive	Personal: 50%
		Negative	Product: 5%
Rigid frame wheelchair without PSD	10.00%	Positive	Personal: 35%
		Negative	Product: 5%
Shower wheelchair	13.19%	Positive	Others: 5%
		Negative	Personal: 24%
Upper limb orthosis	23.26%	Positive	Intervention: 48%
		Negative	Personal: 16%
Upper limb prosthesis	53.33%	Positive	Product: 8%
		Negative	Environmental: 2%
Walker	30.77%	Positive	Others: 12%
		Negative	Personal: 5%
		Positive	Intervention: 40%
		Negative	Personal: 30%
		Positive	Product: 15%
		Negative	Others: 10%
		Positive	Personal: 50%
		Negative	Product: 50%
		Positive	Personal: 100%
		Negative	0%
		Positive	Personal: 48.1%
		Negative	Intervention: 18.5%
		Positive	Product: 14.8%
		Negative	Environmental: 11.1%
		Positive	Personal: 3.7%
		Negative	Personal: 28.6%
		Positive	Intervention: 31.8%
		Negative	Product: 19.1%
		Positive	Personal: 14.3%
		Negative	Environmental: 3.2%
		Positive	Others: 9,5%
		Negative	Personal: 37.5%
		Positive	Intervention: 25%
		Negative	Personal: 25%
		Positive	Product: 12.5%
		Negative	Personal: 75%
		Positive	Intervention: 8.3%
		Negative	Environmental: 8.3%
		Positive	Others: 8.4%
		Negative	

chances to use assistive products once they diminish as time goes on.

This can be related to the fact that rehabilitation motivates the user and usually requires the user to actively use the device as part of his/her treatment, as well as for his/her training. Thus, short-term use is positively influenced by the rehabilitation treatment, as it increases the chance to use an assistive product (2.25).

Furthermore, long-term use is hindered by the completion of the rehabilitation treatment, once chances to use an assistive

device diminish as time goes on (2.74 during the first year, 0.80 after the first year and 0.24 after the third year). This factor reiterates the need for follow up after discharge from the rehabilitation treatment.

By means of a systematic follow up, service providers are able to identify changes in the physical and functional conditions of the user, on its actual and intended uses, on the maintenance of the product and even on the environments where the device has been used, besides identifying possible flaws in former steps of service provision, such as fitting or training on the safe and

effective use of the device [19]. All of these are important factors that diminish the chances to use assistive devices on the long-term and increase abandonment levels.

Another meaningful factor for users adherence to the use of assistive products, which would benefit from specific measures aimed at it by health and rehabilitation systems, services and professionals, is trying to promote (still during treatment) the perception of importance about the use of assistive products among their users, for chances to use assistive products are higher (3.84) among those who perceive it as significant.

The assistive products included in this study reflect the range of products offered by the Brazilian Public Healthcare System for users with physical disabilities and mobility impairments. Among them, upper and lower limb prostheses, walkers and crutches have an overall abandonment level of above the 30% index.

As per this study, the highest abandonment rates are associated with upper limb prosthesis (53.3%; mainly due to negative factors). This might be a result of upper limb prostheses which are still not functional. These users might function better using adaptors than using the products which are currently available. This gets remarkably clear once one notices that 37.5% of users indicate their own functional improvement as the reason for abandoning prostheses.

Secondly, lower limb prostheses have an abandonment level of 33.87%, mainly due to negative factors which are intervention-related and personal, such as inadequate size and difficulties in adapting to the use of prostheses. This might be related to problems in the assessment or prescription. Many times, stumps are short or the prescription was aimed at attending esthetic needs, which might not be a real demand by the user, especially after functional gains resulting from the rehabilitation treatment [20].

With reference to walkers and even to crutches, the evident nature of temporary use can be captured once one perceives that the factors contributing towards their abandonment levels are mostly positive and related to improvements in health and functioning conditions of users.

Positive factors are not only related to products whose use are temporary, such as walkers and crutches or even upper limb prostheses, as per the reasons explained before. Among the 13 assistive products included in this study, there are six for which at least 50% of factors are positive, especially wheelchairs.

Among wheelchairs, shower wheelchairs, rigid frame wheelchairs (both with and without PSD) and folding frame wheelchairs (without PSD) present low abandonment levels and make a significant contribution to the levels of positive abandonment factors, what might also reflect the temporariness of their use. However, these devices are not currently received by the Brazilian Public Healthcare System after they are no longer used, which is a missed opportunity to save resources.

Unfortunately, personal factors for the abandonment of assistive products are not restricted to positive ones. Some personal factors cause a negative impact over the use of assistive products, such as difficulties in adapting to or accepting their use or even worst health and functioning status, which include new diseases and injuries. These factors are especially important for the use of prostheses, crutches, folding frame wheelchairs with postural support devices and Knee Ankle Foot Orthosis (KAFO).

In a recent publication [20], authors indicate that worsened health conditions are a major factor for the abandonment of assistive products. Nevertheless, curiously, this factor was not equally significant in this study.

Other possibly suggestive negative factors are those related to the intervention itself. There are several assistive products for

which more than 25% of users reported an intervention-related factor as a determinant for its abandonment. Notably, intervention-related factors are appointed by more than 40% of users as having been determinant for abandoning lower limb prostheses (for the reasons explained before) and lower limb orthoses, especially KAFO.

Products themselves, if of poor quality, can be prematurely worn out or broken and thus be abandoned by their users. Factors such as deterioration, lack of adjustments and frequent damages are indicated by other authors [20–22] as possible causes for the lack of effectiveness and durability, which negatively affect their use [14]. Symptomatically, folding frame wheelchairs with PSD are the devices for which product-related factors are most important. Users frequently report that folding frame wheelchairs, as well as PSD, are rapidly worn out, hindering their use.

The users of folding frame wheelchairs with PSD are also among those that report to face environmental barriers to use their devices and hence to abandon it. Environmental factors are also significant for users of shower wheelchairs, walkers and crutches. It is worth mentioning that environmental barriers are found outdoors, on the streets, public buildings and transport system, and indoors, in users' homes (what is especially true for shower wheelchair users).

As previously stated, the health system and assistive products service provision themselves could be a barrier that prevent the use of assistive products [20,23]. In Brazil, the Public Healthcare System is the main provider of assistive products, what simplifies access to assistive products and services. Out of the Public Healthcare System, there are other possible alternatives, for which users often appeal when they go to court to ensure their access to assistive products. However, this study only includes users who were appropriately serviced by the Brazilian Public Healthcare System, that guarantees some level of homogeneity among them.

This study also has some twolimitations. First, the number of survey respondents is only a fraction of the total number of service users, hence limiting the number of users in some categories and second, the assistive products covered by the survey are limited to mobility devices, which is due to the kind of rehabilitation services provided and the target-audience of the Institute.

The geographical area covered by the Institute, although restricted to the neighboring cities of Sao Paulo, ensures a service coverage that embraces an expressive population within one of the largest cities and metropolitan areas in the world (nearly 22 million people in 2016).

This study's approach to the theme is certainly innovative in our region. The sample size and the face-to-face interviews all contribute to sound data that aids in strategic decision making on the provision of assistive products.

## Conclusion

83.5% of the users use at least one of the assistive products they have received. Moreover, the general abandonment level of assistive products was 19.38%. The majority of users (81.65%) received up to three assistive products, resulting in a ratio of 1.99 products and provided and of 1.56 products effectively used per user.

The simultaneous use of multiple assistive products, users perception on the importance of using them and completing the rehabilitation treatment were found to impact on the short- and long-term use of assistive products.

Rigid and folding frame wheelchairs, with and without PSD, as well as shower wheelchairs, presented the lowest abandonment levels, followed by canes and lower limb orthoses. Upper limb

orthoses, KAFO, walkers, crutches and lower and upper limb prostheses all presented higher abandonment levels. We believe these data could assist informing decision making on assistive products provision and servicing in similar settings.

From a systems perspective, this study provides information on the expected demand for assistive products for people with physical disabilities in a developing country. It offers a glance about user's characteristics, the range of products that could be made available to persons with mobility impairments and inputs to estimate resource use and financial impact.

It also highlights the impact of associating rehabilitation treatment and assistive products provision and of following up on users for short- and long-term use. The study also demonstrates the importance of considering the need for reusing assistive products for the environmental and financial sustainability of assistive technology service provision.

At service delivery level, it shed light on the assistive products that require special attention by service personnel for their safe and effective use, meaning greater focus on user assessment, prescription, training and follow up. It also offers an insight into the importance of considering the simultaneous use of multiple devices when trying to meet the often complex needs of users. Reiterating a user-centered approach, the study also stresses the need to consider their awareness and individual standing with reference to the assistive products provided.

### Questions used in the interviews

- Are you a patient, former patient or caregiver/personal assistant?
- What is the user's gender? (male/female)
- What is the user's date of birth?
- Is the user currently under rehabilitation treatment? (yes/no)
- When did the user start rehabilitation treatment?
- When has the user stopped rehabilitation treatment?
- Has the user received any kind of device to assist his/her rehabilitation? (yes/no)
- What devices has the user received? (upper limb prosthesis, lower limb prosthesis, upper limb orthosis, lower limb orthosis, KAFO, rigid frame wheelchair without PSD, rigid frame wheelchair with PSD, folding frame wheelchair without PSD, folding frame wheelchair with PSD, shower wheelchair, walker, crutches and cane)
- Does the user use the devices he/she has received? (yes/no)
- What devices does the user use? (upper limb prosthesis, lower limb prosthesis, upper limb orthosis, lower limb orthosis, KAFO, rigid frame wheelchair without PSD, rigid frame wheelchair with PSD, folding frame wheelchair without PSD, folding frame wheelchair with PSD, shower wheelchair, walker, crutches and cane)
- Does the user have any difficulties in using the devices received? (yes/no)
- What difficulties does the user have in using the devices received? (open answer)
- If the user doesn't use some of the devices he/she received, why is it? (it does not perform the intended function, it does not fit the user, user conditions improved and he/she no longer needs the device, user conditions worsened and the device does not meet his/her current needs, the user has not adapted to use the device, the user cannot wear the device, the user does not accept the device, the user feels discriminated when using the device,

the device was stolen, the device was lost, the device is broken or worn out, there are physical barriers that prevent the use of the device and open answer)

- In a scale that goes from 1 to 5, in which 1 is not important and 5 is very important, how important is the use of assistive devices during rehabilitation treatment? (1. not important, 2. a bit important, 3. indifferent, 4. Important and 5. very important)

### Disclosure statement

No potential conflict of interest was reported by the authors.

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# Global perspectives on assistive technology

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# Global perspectives on assistive technology

Proceedings of the GReAT Consultation 2019

**Volume A – Day 1**

## Foreword

The World Health Assembly recognizes the need for improving the access to assistive technology across the world and, through its resolution 71.8, has commissioned the World Health Organization to prepare a global report on effective access to assistive technology by 2021. The development of the Global Report on Assistive Technology (GReAT) is led by a Steering Committee with representatives from the WHO Secretariat, the Global Cooperation on Assistive Technology (GATE) and UNICEF, and an Ad-hoc Advisory Group of Experts on Assistive Technology. The work is carried out in collaboration with international experts and stakeholders in assistive technology.

As a first step to inform the development of the Global Report, WHO Headquarters in Geneva hosted the GReAT Consultation on 22-23 August, 2019. Over 260 participants from 60 countries representing academia, civil society, users of assistive technology, global assistive technology stakeholders, States and UN agencies participated in this global consultation.

There was an overwhelming response to the call for contributions addressing the objectives of the Global Report, which are to highlight the current need, demand and supply of assistive technology, as well as to outline good practices for innovation and recommendations to improve access. More than 130 abstracts were submitted, and following a review process considering the relevance, quality and geographic representation, over 80 manuscripts or illustrative contributions were subsequently invited to be developed into full manuscripts for presentation at the GReAT Consultation.

Contributions were sought to illuminate the range and breadth of assistive technology and to recognise the diversity of stakeholders within the complex system of assistive technology. An encompassing view of evidence ensured that evidence-based practice, practice-based evidence, and situated knowledges were recognised and considered. Submitted manuscripts were reviewed from academic, technical and accessibility perspectives. These Proceedings represent the first foundation for the Global Report. Its 76 sections comprise 72 manuscripts and four abstracts, and are presented across eight themes:

- |                            |                                      |
|----------------------------|--------------------------------------|
| 1. Needs and supply        | 5. Procurement and service provision |
| 2. Access                  | 6. Capacity building                 |
| 3. Outcomes                | 7. Innovations                       |
| 4. Policies and programmes | 8. Enabling the sector               |

Many sections are authored by international groups of authors, and a substantial proportion were received from author teams who had not previously published. All authors are to be congratulated on sharing their knowledge and perspectives. The sections present a 'state of the science' for the assistive technology sector in 2019 at a time of great need and great opportunity.

Work will now continue to identify and fill knowledge gaps, collect data and listen to unheard voices to further inform the development of the Global Report. Our sincere wish is that the spirit of the GReAT Consultation – great things happen when great people meet – will inspire us to continuous concerted efforts to improve the access to assistive technology worldwide.

*Natasha Layton and Johan Borg*  
Editors

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Ultimately, tribute must be paid to Chapal Khasnabis for guiding the programme development and for an encompassing approach to contributions. His visionary leadership over many years has led to this pivotal moment for assistive technology access globally.

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### **Abstract**

International trade is an important component of assistive technology sustainability at a global level, and directly relates to the supply and availability of assistive products (AP) in many countries. Aiming at (i) presenting how AP can be identified, grouped and tracked using Harmonized System (HS) codes; (ii) identifying the global export/import flows of AP, as well as market concentration for supplying and importing countries; and, (iii) identifying bound tariffs, most favored nation (MFN) tariffs, and non-MFN (preferential) tariffs effectively applied to AP; this manuscript presents the findings of an initial exploratory quantitative study on international trade flows and tariffs of AP using open access databases pertaining to the World Trade Organization (WTO), the World Customs Organization (WCO) and the United Nations International Trade Statistics Database (UN Comtrade). Relying on a set of WCO Harmonized System (HS) codes, data for this analysis comes from the International Trade Centre's (ITC) Trade Map. Data on applicable tariffs were collected using the WTO Tariff Download Facility and uses the latest available reports from all WTO member countries that reported their bound, MFN and preferential tariffs. In 2017, the total trade value of AP reached almost USD 144.4 billion. A valuable and global market as it is, Herfindahl indices show that it is also a concentrated market for both supplying and importing countries, and that the share of low- and middle-income countries (LMIC) in this market is limited. Data shows that orthotics and prosthetics devices accounted for more than 40% of the total trade value in 2017, followed by glasses, lenses, frames and spectacles (30.1%). AP are also subject to a number of different tariffs. Data shows that approximately 25% of all reporting countries have bound their tariffs on AP at 0%. Notwithstanding their bound tariffs, countries often choose to apply lower tariffs to their trade partners. Data from 150 countries that reported on their MFN tariffs shows that many apply a 0% tariff on many AP as well. Apart from MFN tariffs, AP are also subject to be included in preferential agreements between trade partners that contribute to lower tariff levels. Additionally, the existence of many tariff lines for the same products highlight a need to further improve Harmonized System codes with respect to AP.

## Keywords

Supply, Availability, Market Concentration

## Introduction

International trade is an important component of assistive technology sustainability at global level, and directly relates to supply and availability of assistive products (AP) in many countries. Many of the papers resulting from the first Global Research, Innovation, and Education in Assistive Technology (GREAT) Summit, held by the World Health Organization (WHO) in 2017, have highlighted that.

MacLachlan and Scherer (1) identified a two-way road between different aspects of supply and a number of topics around systems thinking in assistive technology, such as procurement, policy, products, and provision, but also promotion and partnerships. De Witte and others (2) highlighted (i) the impact that the lack of an economy of scale has for many AP; (ii) the level of fragmentation of the existing AP market; (iii) the lack of participation of low- and middle-income countries (LMIC) in the global AP market; and (iv) the importance of establishing effective supply and delivery chains to improve provision around the world. Moreover, MacLachlan and others (3) stressed that market shaping could be an efficient tool to promote effective market supply and a favorable market environment that might collaborate to bridge the gap between the met and unmet needs for AP.

Although market shaping and other tools are not directly mentioned in the “Global priority research agenda for improving access to high-quality affordable assistive technology” (4), published by WHO in 2017, it is clear that exploring demand and supply is crucial to addressing many of its thematic areas and to deliver on the market potential and great opportunities that the agenda presents for the industries and populations worldwide.

Hence, aiming at (i) presenting how AP can be identified, grouped and tracked using the World Customs Organization (WCO) Harmonized System (HS) codes; (ii) identifying global export/import flows of AP, as well as market concentration for supplying and importing countries; and, (iii) identifying bound tariffs, most-favored-nation (MFN) applied tariffs and non-MFN (preferential) applied tariffs; this manuscript presents the findings of an initial exploratory quantitative study on international trade flows and tariffs of AP using open access databases pertaining to the World Trade Organization (WTO), the WCO and the United Nations International Trade Statistics Database (UN Comtrade).

With regard to market concentration, the Herfindahl index is an indicator calculated by squaring the share of each country in the selected market and by summing the resulting numbers. Antitrust authorities such as the USA Federal Trade Commission use the Herfindahl index as a screening tool to identify harmful market concentration. They consider Herfindahl indices between 0.1 and 0.18 to be moderately concentrated and indices above 0.18 to be concentrated (5).

With reference to different types of tariffs, bound rates are specific commitments made by individual WTO member states, acting as a ceiling rate for any applied tariff. MFN tariffs are what countries promise to impose on imports from other members of the WTO, unless the country is part of a preferential trade agreement, in which case a mutually agreed non-MFN (preferential) rate applies (6).

### **Approach**

Tracking international trade data depends on search strategies that use WCO HS codes in order to identify products of interest. At an international level, products can only be identified, and data collated at the 6-digits level or lower (2 and 4-digits). The current version of the HS was adopted by the WCO in 2017 and has product categories that cover many AP. Unfortunately, not all codes and products descriptions are strictly related to AP, as is the case with 902190.

Relying on this set of HS codes, data for this initial analysis comes from the International Trade Centre's (ITC) Trade Map, an application that uses the UN Comtrade Database and provides both raw data on import and exports and trade indicators. ITC is a joint agency of the WTO and the UN (5).

Data on applicable tariffs were collected using the WTO Tariff Download Facility (7), and uses the latest available reports from all WTO member countries that reported their bound tariffs, MFN tariffs, and preferential tariffs effectively applied to AP.

Considering this is an initial exploration of the data, the analysis only uses descriptive statistics to provide insights on the objectives set forth for the study.

### **Findings**

Table 1 presents the HS codes used in order to identify, group and track AP of interest. All the data and analysis presented and discussed in this manuscript is based either on these codes or on reporting countries and territories.

Table 2 presents exported and imported values, as well as the share of each product group in total trade values of AP. In 2017, the sum of total imported and exported values for AP in the world reached almost USD 144.4 billion.

A valuable and global market as it is, a first glance at Herfindahl indices shows that it is also a concentrated market for both supplying and importing countries for many product codes. Table 3 shows the Herfindal Index for each product code included in the analysis.

Table 1. Harmonized System codes and descriptions organized in product groups

<b>Product Groups</b>	<b>HS 17 Codes</b>	<b>Product Descriptions</b>
Wheelchairs	871310	Carriages for disabled persons, not mechanically propelled
Wheelchairs	871390	Carriages for disabled persons, motorized or otherwise mechanically propelled (excluding specially designed motor vehicles and bicycles)
Wheelchairs	871420	Parts and accessories for carriages for disabled persons, n.e.s
Orthotics and Prosthetics	902110	Orthopedic or fracture appliances
Orthotics and Prosthetics	902131	Artificial joints for orthopedic purposes
Orthotics and Prosthetics	902139	Artificial parts of the body (excluding artificial teeth and dental fittings and artificial joints)
Glasses, Lenses, Frames and Spectacles	701510	Glasses for corrective spectacles, curved, bent, hollowed or the like, but not optically worked (excluding flat glass for such purposes)
Glasses, Lenses, Frames and Spectacles	900130	Contact lenses
Glasses, Lenses, Frames and Spectacles	900140	Spectacle lenses of glass
Glasses, Lenses, Frames and Spectacles	900150	Spectacle lenses of materials other than glass
Glasses, Lenses, Frames and Spectacles	900311	Frames and mountings for spectacles, goggles or the like, of plastics
Glasses, Lenses, Frames and Spectacles	900319	Frames and mountings for spectacles, goggles or the like (excluding of plastics)
Glasses, Lenses, Frames and Spectacles	900390	Parts of frames and mountings for spectacles, goggles or the like, n.e.s
Glasses, Lenses, Frames and Spectacles	900490	Spectacles, goggles and the like, corrective, protective or other (excluding spectacles for testing eyesight, sunglasses, contact lenses, spectacle lenses, and frames and mountings for spectacles)
Hearing Aids	902140	Hearing aids (excluding parts and accessories)
Others	902190	Articles and appliances, which are worn or carried, or implanted in the body, to compensate for a defect or disability (excluding artificial parts of the body, complete hearing aids and complete pacemakers for stimulating heart muscles)



*Table 2. Exported and imported values, and share in total trade values for each product group in 2017 (presented in US Dollar thousands)*

<b>Product Groups</b>	<b>Exported Value</b>	<b>Imported Value</b>	<b>Share in Total AP Trade</b>
Wheelchairs	2,417,174	2,452,624	3.4%
Orthotics and Prosthetics	29,539,125	31,812,913	42.5%
Glasses, Lenses, Frames and Spectacles	21,688,149	21,845,722	30.1%
Hearing Aids	3,538,291	4,321,260	5.4%
Others	13,732,098	13,062,565	18.6%
<b>Total</b>	<b>70,914,837</b>	<b>73,495,084</b>	<b>100%</b>

*Table 3. Herfindal indices of supplying and importing countries for each product code in 2017*

<b>Product Code</b>	<b>Concentration of supplying countries</b>	<b>Concentration of importing countries</b>
871310	0.25	0.08
871390	0.17	0.09
871420	0.12	0.11
902110	0.15	0.08
902131	0.15	0.09
902139	0.16	0.06
701510	0.24	0.14
900130	0.12	0.08
900140	0.12	0.08
900150	0.1	0.06
900311	0.33	0.08
900319	0.32	0.07
900390	0.26	0.1
900490	0.26	0.08
902140	0.1	0.1
902190	0.13	0.08

A closer look on imported and exported values by countries and territories highlight the lack of participation of LMIC. Tables 4 and 5 show the major exporters and importers ranked according to their import and export values in 2017, respectively.

*Table 4. Major exporting countries and territories ranked according to exported value in 2017 (presented in US Dollar thousands)*

<b>Exporter</b>	<b>Exported value</b>	<b>Share in total exports</b>
United States of America	10,497,571	14.8%
China	8,905,582	12.6%
Mainland China	5,713,157	8.1%
Hong Kong SAR	2,088,060	2.9%
Taiwan, China	1,104,365	1.6%
Netherlands	7,733,641	10.9%
Germany	6,225,504	8.8%
Ireland	6,004,714	8.5%
Switzerland	4,847,436	6.8%
Belgium	3,718,467	5.2%
France	2,674,293	3.8%
United Kingdom	2,540,250	3.6%
Singapore	2,273,490	3.2%
Italy	2,077,181	2.9%
Mexico	1,463,593	2.1%
Poland	1,197,663	1.7%
Thailand	1,103,844	1.6%
Denmark	1,006,292	1.4%
World exports	70,914,830	100.0%

*Table 5. Major importing countries and territories ranked according to imported value in 2017 (presented in US Dollar thousands)*

<b>Importer</b>	<b>Imported value</b>	<b>Share in total imports</b>
United States of America	14,921,707	20.3%
Germany	6,213,614	8.5%
China	5,342,174	7.3%
Mainland China	3,833,374	5.2%
Hong Kong SAR	1,508,800	2.1%
Netherlands	5,327,972	7.2%
Japan	4,353,164	5.9%
France	4,063,763	5.5%
United Kingdom	3,388,099	4.6%
Belgium	2,876,648	3.9%
Italy	2,449,175	3.3%
Switzerland	1,996,661	2.7%
Canada	1,854,662	2.5%
Australia	1,731,271	2.4%
Spain	1,431,800	1.9%
Singapore	1,084,337	1.5%
Korea, Republic of	960,731	1.3%
Russian Federation	835,244	1.1%
World imports	73,495,050	100.0%

Apart from data on international trade flows, the study also intends to explore data on tariffs, the customs duties that usually take the form of ad valorem tariffs, which are calculated as a percentage (rate) of the value of the product (6).

Table 6 presents several aspects related to bound tariffs. Among the 136 reporting countries, it presents the percentage of countries that chose to bound, unbound or partially bound their tariffs for each product code. Partially bounding their tariffs means that countries hold more than one tariff line for that product code, and that only a part of them are bounded. By bounding their tariffs, countries establish ceiling which they commit to apply to imported products. As such, the binding coverage for each product reflects the predictability of the market.

Besides showing the percentage of tariffs bounded at 0%, it also shows the median tariff and the tariff range for those tariffs that are not bounded at 0%.

*Table 6. Percentage of countries with bound, unbound and partially bound tariffs, as well as the percentage of tariffs bounded at zero, and median tariff and tariff range for rates not bounded at zero, for each product code in 2017 (all rates presented in %)*

<b>Product Code</b>	<b>Countries with Bound Tariffs</b>	<b>Countries with Unbound Tariffs</b>	<b>Countries with Partially Bound Tariffs</b>	<b>Tariffs Bounded at 0%</b>	<b>Median Bound Tariff</b>	<b>Bound Tariffs Range</b>
871310	72.1	27.9	0.0	32.7	35	5-100
871390	72.1	27.9	0.0	32.7	35	4-100
871420	73.5	25.7	0.7	28.7	35	5-100
902110	77.2	22.8	0.0	29.5	35	4-110
902131	77.2	22.8	0.0	31.4	35	4-110
902139	77.2	22.8	0.0	31.4	35	4-110
701510	74.3	25.7	0.0	5.9	30	1-100
900130	74.3	25.7	0.0	9.9	30	1-100
900140	75.7	24.3	0.0	4.9	25	1-100
900150	75.0	25.0	0.0	5.9	27.5	1-100
900311	74.3	25.7	0.0	2.0	30	2.2-100
900319	72.8	27.2	0.0	4.0	30	2.2-100
900390	73.5	26.5	0.0	3.0	30	1-100
900490	72.8	25.7	1.5	3.0	30	2.5-100
902140	77.2	22.8	0.0	31.4	35	4-110
902190	78.7	21.3	0.0	33.6	35	2.1-110

Table 7 shows the percentage of countries, among the 150 reporting countries, which chose to set their MFN tariffs at 0%, as well as the median rates and tariff range for those countries that did not zeroed the import tariffs applied to their trade partners, for each product code. The largest the tariff range and the difference between the bound and applied MFN rates, the most unpredictable trade policies are (6).

*Table 7. Percentage of countries with MFN tariffs set at zero, and median tariff and tariff range for rates not set at zero, for each product code in 2017 (all rates presented in %)*

<b>Product Code</b>	<b>MFN Tariffs at 0%</b>	<b>Median MFN Tariff</b>	<b>MFN Tariffs Range</b>
871310	74.0	5	2-26
871390	74.0	5	2-26
871420	72.0	5	2-26
902110	62.0	5	1-26
902131	64.7	5	1-26
902139	64.7	5	1-26
701510	43.3	5	1-26
900130	37.3	5	1-26
900140	37.3	7.5	0.7-32
900150	38.0	7.5	0.7-32
900311	24.7	10	1.3-35
900319	25.3	10	2-35
900390	25.3	5	1-35
900490	18.0	7.5	2-30
902140	68.0	5	1-26
902190	62.7	5	0.5-26

As countries might agree on preferential tariffs to be applied for free trade areas or customs unions, for example, for each product code, Table 8 presents the number of reporting countries, the number of reported preferential tariffs and the percentage of preferential tariffs zeroed, as well as the median tariff and tariff range for those rates that were not zeroed.

Although international agencies like the WTO and WCO can only use information up to the 6-digits level to collate and compare data across countries, these are free to create additional tariff lines for each product code. Tables 9 and 10 show the percentage of reporting countries that chose to apply one, two to four, or more than five tariff lines to each product code for their MFN and preferential tariffs, respectively. Additional national tariff lines can be used to further refine tariffs as well as for statistical purposes.

Table 8. Information on reporting countries and reported preferential tariffs for each product code in 2017.

Product Code	Reporting Countries	Reported Preferential Tariffs	Preferential Tariffs at 0%	Median Preferential Tariff	Preferential Tariff Range
871310	20	54	83%	4.5%	1-40%
871390	20	54	87%	2%	1-15%
871420	20	59	86%	4.75%	1-60%
902110	30	135	82%	4.4%	0.1-55%
902131	27	107	79%	4.4%	0.4-55%
902139	27	106	77%	4.4%	0.4-40%
701510	52	292	89%	7.6%	1-40%
900130	56	335	94%	2.75%	2-40%
900140	53	357	95%	4%	0.5-40%
900150	54	360	94%	4.25%	0.55-40%
900311	70	411	92%	5%	1-50%
900319	70	374	91%	5%	1-50%
900390	74	429	90%	4.4%	1-50%
900490	76	451	89%	8.9%	0.33-40%
902140	27	109	80%	4.4%	0.4-35%
902190	30	122	82%	8.2%	0.4-35%

Table 9. Number of reporting countries and percentage of countries applying 1, 2 to 4 or 5 or more MFN tariff lines to each product code in 2017.

Product Code	Number of reporting countries	1 Tariff Line	2-4 Tariff Lines	5+ Tariff Lines
871310	150	97.3%	2.7%	0.0%
871390	150	96.7%	3.3%	0.0%
871420	150	91.3%	8.7%	0.0%
902110	150	66.0%	27.3%	6.7%
902131	150	96.0%	3.3%	0.7%
902139	150	66.7%	27.3%	6.0%
701510	150	94.0%	6.0%	0.0%
900130	150	96.0%	4.0%	0.0%
900140	150	62.0%	38.0%	0.0%
900150	150	60.7%	39.3%	0.0%
900311	150	95.3%	4.7%	0.0%
900319	150	68.7%	29.3%	2.0%
900390	150	88.0%	11.3%	0.7%
900490	130	33.8%	61.5%	4.6%
902140	150	99.3%	0.7%	0.0%
902190	150	65.3%	29.3%	5.3%

Table 10. Number of reporting countries and percentage of countries applying 1, 2 to 4 or 5 or more preferential tariff lines to each product code in 2017.

Product Code	Number of reporting countries	1 Tariff Line	2-4 Tariff Lines	5+ Tariff Lines
871310	54	98,1	1,9	0,0
871390	54	98,1	1,9	0,0
871420	59	59,3	40,7	0,0
902110	135	30,4	40,0	29,6
902131	107	99,1	0,9	0,0
902139	106	40,6	58,5	0,9
701510	292	92,8	7,2	0,0
900130	335	89,0	11,0	0,0
900140	357	50,4	49,6	0,0
900150	360	48,3	51,7	0,0
900311	411	93,7	6,3	0,0
900319	374	74,6	24,3	1,1
900390	429	92,1	7,2	0,7
900490	451	28,4	64,3	7,3
902140	109	100,0	0,0	0,0
902190	122	41,0	36,1	23,0

## Discussion

Regarding the appropriateness of the HS codes to adequately identify AP, wheelchairs and hearing aids, as well as glasses, are in a much better position than orthotics, prosthetics and others, which would certainly benefit from improvements in their coding. Both the description and the significance of 902190 (Articles and appliances, which are worn or carried, or implanted in the body, to compensate for a defect or disability) in terms of its share of the total trade values (above 18%), adds a striking note on the need for its refinement. Nevertheless, by looking at the number of countries that create additional national tariff lines for the codes used in this study, we see that spectacles lenses, spectacles and orthotics and prosthetics score even higher. On the other hand, wheelchairs and hearing aids seem to have more appropriate codes, despite the high number of additional tariff lines for wheelchairs parts and accessories between preferential trade partners.

Despite the effect caused by the unprecise description of 902190, it is possible to see that orthotics and prosthetics (42.5%) and spectacles and its parts (30.1%) concentrate a significant share of the market. They are only distantly followed by hearing aids (5.4%) and wheelchairs (3.4%). Once we have only used export and import aggregated values, it is not possible to say if this is caused by differences in trade volumes or prices.

Apart from the product groups that concentrate trade flows, data also shows high market concentration levels for many product codes. Data on global imports indicates that Herfindahl indices for all AP are above 0.1, which indicates some level of market

concentration of supplying countries. As a matter of fact, six out of the 16 product categories show indices above the 0.18 threshold, indicating concentrated markets. On the other hand, data on global exports demonstrate that only four products in the list have Herfindahl indices of 0.1 or higher, indicating a lower concentration of importing countries.

Additionally, although data from 2017 shows that 223 countries imported AP, only 17 countries accounted for more than 80% of world imports, all of them either High-Income or Upper-Middle-Income Economies, as per World Bank classification. Figures for exporters are not much different. Although there were 188 exporting countries in 2017, only 17 countries exported more than USD 1 billion, totaling more than 87% of world exports. Again, all of them scored high in World Bank classifications. Hence, despite the significant size of their markets and regional or global industrial potential, only China, Mexico, Thailand, and the Russian Federation are among the major world exporters and importers. Despite not being evident in this manuscript, other LMIC, like Brazil, Viet Nam, the Dominican Republic, and Algeria have some level of participation in specific markets, such as for spectacles and its parts.

Essential to explore international trade, diving into customs tariffs is important as they inform about the predictability of the market and assist us in identifying areas for international orchestrated action and negotiation in order to reduce barriers to trade and facilitate and improve the supply and availability of imported products.

As such, AP are subject to several different types of tariffs (bound, MFN, and non-MFN preferential tariffs, as previously mentioned). By committing to bound their “ceiling” tariffs, countries increase the binding coverage, hence improving market predictability (6). Data demonstrates that 70-80% of all 136 reporting countries bound their tariffs on AP, with “9021” products scoring higher, above 75%. Moreover, it shows that approximately a third of these countries chose to bound their tariffs at 0%. As such, almost 20% of all reporting countries have bound their tariffs on AP at 0%, although wheelchairs, hearing aids and orthotics and prosthetics have much higher level of tariffs bounded at 0% (around 30%) than spectacles and its parts (below 10%). For the remaining reporting countries that did not bound their tariffs on AP at 0%, the median tariff was around 30-35%, although actual tariffs still ranged from 1% to 110%. Hence, the tariffs binding status, despite its relevance to diminish possible variations, has a limited effect for those countries that did not zero their tariffs on AP.

Notwithstanding their bound tariffs, countries often choose to apply lower tariffs to their trade partners. Data from 150 countries that reported on their MFN tariffs shows that many apply a 0% tariff on many AP, as well (above 60% of the reporting countries for all product groups, except spectacles and its parts). For the remaining countries, the median applied MFN tariff was around 5 to 10%, with tariff levels ranging from 1 to 35%. Thus, in practice, no country applies a tariff (whether bound or unbound) higher than 35% to any AP, though the gap between the bound and applied MFN rates (tariff overhang) is still substantial, demonstrating some level of market unpredictability.

Apart from MFN tariffs, AP are also subject to be included in preferential agreements between trade partners that contribute to lower tariff levels. In many such cases, reporting countries have also chosen to zero their tariffs on AP (circa 80% of applied non-MFN tariffs on orthotics, prosthetics and hearing aids, above 83% on wheelchairs, and approximately 90% for glasses, lenses, frames and spectacles). As with MFN tariffs, the median non-MFN preferential tariffs that were not zeroed is below 10%.

## Conclusions

Exploring data on international trade and tariffs depends on HS coding, hence our efforts to use product categories that relate with AP. However, HS codes might not be directly applicable to many AP. For those categories that exist, countries still create several tariff lines for the same HS subheadings that are not comparable, demonstrating a need for further detail in products classifications. The international community would certainly benefit if these could be aligned with other references such as ISO 9999:2016 (Assistive products for persons with disability) (8), which establishes a widely accepted classification and terminology of assistive products, increasing the level of data comparability internationally.

Additionally, as countries can report the quantities of exported and imported goods in terms of both individual units and overall weight, data is not readily comparable across all countries. Creating and consolidating search and analysis strategies is fundamental to exploring AP trade and tariffs at a global level.

The data presented and analyzed demonstrates that the market is concentrated around some groups of products and countries, with limited participation of LMIC. Additionally, despite the significant binding coverage established by WTO member countries, the binding overhang is still considerable. Information on preferential trade agreements that include customs duties on AP demonstrate that there is an opportunity for negotiation at international level, and that the international community would benefit from diminishing the barriers to the international trade of AP.

Further studies on this topic would be able to provide additional information about trends in AP trade over time, as well as providing more detailed data on importers and exporters. Further efforts could also serve to explore possible relations between countries level of income, unit prices, countries' share in the world market, markets concentration and applied tariffs to shed a light on high level determinants of products quality, affordability and availability at local level in many countries.

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## THE CHALLENGES OF IMPROVING ASSISTIVE TECHNOLOGY PROVISION WHILE REDUCING REGIONAL INEQUALITIES IN BRAZIL

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### ABSTRACT

**Purpose:** The study aims at investigating if current assistive products provision in Brazil will be able to deliver on the goal set by the 2020-2023 National Health Plan to increase the number of products provided and reduce regional inequalities within the country. **Methods:** A desk-based search of secondary data gathering information from the Brazilian health information system on outpatient care collected data on assistive products provision from 2008 to 2019, comprising mobility, hearing and visual aids, and orthotics and prosthetics. Results are disaggregated by Brazilian states and administrative health regions. **Results:** Provided that assistive products provision continues to increase, it is probable that the 2023 target will be met. Over recent years, provision of mobility aids, orthotics and prosthetics, and hearing aids improved in most territories, with visual aids showing shier results. While the coverage of all types of assistive products provision improved, delivery of mobility aids and orthotics and prosthetics outperformed the others. States in the southern regions had consistently increased their coverage of almost all types of assistive products, while those in the north and north-eastern regions apparently stagnated. **Conclusion:** Brazil has shown progress in improving assistive technology provision since the adoption of the Convention on the Rights of Persons with Disabilities and the 2011 National Disability Strategy which are largely due to pre-existing capacities and additional resources invested in its public healthcare system. Nevertheless, policymakers, managers and service providers still face many challenges to reduce the inequalities in resource distribution between the regions.

### KEYWORDS

Health inequalities; human rights; healthcare systems; disability.

### IMPLICATIONS FOR REHABILITATION

- Assistive technology provision and rehabilitation service delivery often overlap, and health policies should make the most of this interplay by building upon synergies between resources allocated for both.
- Decentralization of assistive technology provision and rehabilitation service delivery are key to improve services coverage.
- Strengthening assistive technology provision and rehabilitation service delivery demands further investments at community-level to improve direct provision as well as referral and follow-up.

## INTRODUCTION

The momentum around ensuring access to assistive technology is getting stronger since the entry into force of the Convention on the Rights of Persons with Disabilities (CRPD) (1,2). National governments and international organizations are building upon the mandate created by the Convention to guarantee systems are in place to provide the assistive products and services people need to have better functioning and quality of life, as enshrined by the World Health Assembly resolution on improving access to assistive technology (3).

Similarly, the urge to improve the provision of assistive technology has increased in Brazil since the adoption of the CRPD in 2008 (4). A few years later, the health components of the National Disability Strategy set to accelerate the pace towards implementing the CRPD focused on improving the supply of rehabilitation services and assistive technology through the Brazilian public healthcare system (5). Mainstream healthcare planning instruments, such as the 2016-2019 National Health Plan (NHP) reinforced the validity of the 2011 National Disability Strategy as a guideline on the health of persons with disability (6).

The most recent Annual Management Report issued by the Brazilian Ministry of Health shows the constant rise in the number of facilities accredited to provide rehabilitation services and assistive technology throughout the past years as evidence of the progress achieved towards the goals set in 2016 (7). Released in 2020, the new NHP further adds to it by aspiring to increase in almost 50% the number of assistive products provided between 2008 and 2018 by 2023, achieving the target of 10 million products delivered since 2008 (8).

This study aims at investigating if current assistive products provision in Brazil will be able to deliver on the goal set by the 2020-2023 NHP to increase the number of products provided and reduce regional inequalities within the country.

## METHODS

The study uses a desk-based search of secondary data gathering information from the Brazilian health information system (HIS) on outpatient care financed by the national public healthcare system and provided for free at point-of-care (9). Ethics appraisal and approval are unnecessary once aggregate data is publicly available and individuals are not identifiable.

It collects data on assistive products provision from 2008 to 2019 using the product categories of the Brazilian HIS, which are consistent with the current definition of assistive products adopted by the World Health Organization, as these are all external products used to improve the functioning and well-being of people in need (10).

As such, they are divided into four categories, which comprise mobility aids (wheelchairs, postural support devices and accessories; adapted shoes and insoles; and walking aids, such as canes, crutches, and walkers); orthotics and prosthetics (orthotics and prosthetics for the spine and upper and lower limbs, and wheelchair cushions); hearing aids (including diverse models and parts); and visual aids (white canes, corrective lenses, low vision telescopes and magnifying glasses), which include their maintenance and repair (11).

The study also shows the disaggregation of assistive products provision by the Brazilian states and the administrative health regions in which they are further divided and the year when products were provided. The period covered by the study ranges from 2008 to 2019 to match

the 2020-2023 NHP and to acknowledge the disruption of services during the 2020 COVID-19 pandemic as well as the six months needed by the Ministry of Health to consolidate data input in HIS.

The study uses descriptive statistics to analyse and present its results. At times, it uses three-year periods and moving means to account for steep variations between years that are attributable to fluctuations in services availability in less resourced areas. It also uses categorical information to characterise sustained provision of assistive products in these periods.

## RESULTS

The yearly supply of assistive products in Brazil has been constantly on the rise since 2008, despite occasional setbacks. To account for these fluctuations, table 01 shows the amounts of assistive products provided each year as well as the cumulative quantities observed and the 3-year moving mean of total assistive products provided.

The 6.4 million assistive products provided since 2008 in 2018 are the baseline for the 2020-2023 NHP target of achieving 10 million products delivered until 2023. It is also the same year the 3-year moving mean rises again after remaining close to 600 thousand products provided per year for four years.

*INSERT TABLE 01 NEAR HERE*

Considering the moving mean registered in 2019 (which is the highest mean in the whole period cover by the study) and replicating it for the consecutive years through to 2023, Brazil could fall slightly short of the 10 million assistive products planned in the 2020-2023 National Health Plan. Provided that this mean continues to increase, it is probable that this target is met.

However, the 2020-2023 NHP also accounts for the objective to reduce regional inequalities within the country, which are only visible if data is disaggregated into the 26 Brazilian states and its federal district, or even its 456 administrative health regions in which they are further divided. Additionally, the 2020-2023 NHP itself reports that performance levels were different between each type of assistive products during the past years, with visual aids lagging notably behind (8).

Table 02 shows the 3-year moving mean values in 2010 (observed before the 2011 National Disability Strategy) and 2019 (most recent consolidated data available and contemporary to the 2020-2023 NHS). It demonstrates the provision of mobility aids, orthotics and prosthetics, and hearing aids improved in most territories, with visual aids showing shier results. As a matter of fact, as anticipated by the country-wide performance of visual aids provision, it shows negative results in most localities.

While the performance of most Brazilian states varies, some show consistently positive results (Amazonas, Espirito Santo and Rio Grande do Sul), others performed poorly throughout (Tocantins, Maranhao, Paraiba and Mato Grosso). Hence, the two southern, better resourced regions in the country performed better in most cases.

*INSERT TABLE 02 NEAR HERE*

Nevertheless, pondering inequalities at the state-level might be as misleading as considering it at the country-level alone once assistive products provision within states are often concentrated in a few places in these territories. To account for it, this study counted the administrative health

regions where at least one assistive product was provided for no less than two of the three years intervals used previously (2008-2010 and 2017-2019).

As such, while the coverage of all types of assistive products provision improved between these periods, delivery of mobility aids and orthotics and prosthetics outperformed (from 19.1% to 30.5%, and from 18.4% to 27.6% of health regions in the country, respectively) the others. Coverage of hearing aids increased from 19.1% to 22.8%, and that of visual aids remained almost unchanged, increasing from 11.6% to 12.1% of health regions.

Table 03 sheds more light into this by showing how coverage varied within each Brazilian state for each type of assistive product. Again, it shows in detail how the provision of mobility aids and orthotics and prosthetics performed better by demonstrating that coverage either remained the same or increased (sometimes significantly), with hearing aids trailing shortly behind.

*INSERT TABLE 03 NEAR HERE*

It also shows that losses in coverage of visual aids provision was significantly larger in the north region. Additionally, states in the southern regions had consistently increased their coverage of almost all types of assistive products, while those in the north and north-eastern regions apparently stagnated.

## **DISCUSSION**

Study's results demonstrate that while some progress has been achieved in terms of improving the supply and variety of assistive products and the coverage of their provision for the past decade, resources remain highly concentrated in some types of assistive products and in wealthier regions of the country.

The progress observed recently might be affected by the disruption of services due to the COVID-19 pandemic as well as by limited resources to finance healthcare in the near future (12,13). Thus the 2020-2023 NHP's targets might demand additional efforts and resources to be secured.

It is also worth noting that the supply of assistive products will have to cope with an increasing demand for such products to protect current progress. With years lived with disability in Brazil showing a rise of more than 90% between 1990 and 2019, the need for technology is certainly increasing on a similar pace (14).

With these initial results, it is important to take a deeper dive into the inequalities still hidden in the current data. As an example, the 2020-2023 NHP shows that although the coverage of specialized rehabilitation services in the country has improved in regions with both higher and lower human development levels, these services are still concentrated on regions showing higher Human Development Indices (8). As assistive products provision is strongly intertwined with rehabilitation services in the country, the situation is probably similar for access to assistive technology.

By integrating assistive technology provision within the public healthcare system since the early 1990's, Brazil took a major step to acknowledge its importance to promote equity and its essential role in universal health coverage, as access to assistive products and related services are both a mean and an end to achieve it (15).

Changes to service delivery models in place could also improve assistive products provision and access to assistive technology. Despite the decentralization of rehabilitation services and its integration into primary healthcare strategies in Brazil, assistive technology service delivery is still restricted to specialized rehabilitation facilities, which are limited. While there are only a few hundreds of specialized rehabilitation facilities accredited by the Ministry of Health, decentralized, local rehabilitation services and family health teams which deliver minimal rehabilitation interventions, referral and follow up are more than 7 thousand (7).

The guidelines for the Brazilian Assistive Technology Plan, expected to be circulated for public consultation in June 2021, have been published by the Brazilian government recently (16) and cover aspects that might influence assistive products provision in the future, such as tax reductions, strengthening supply chains, and improving assistive technology service delivery through the Brazilian public healthcare system and other programs. Hence, the forthcoming Plan should be in the best position to foster the dual objective of not only increasing supply but also reducing inequalities set forth in the 2020-2023 NHP.

The challenges to overcome disparities within countries, which are associated with the lack of resources and the availability and sustainability of service delivery, are identified by many of WHO Member States (15). Strengthening assistive technology provision and service delivery is a strategy to be used while acknowledging such an “open system” in dependent upon its environment, hence demanding stakeholders articulate policies in different sectors and enabling interventions that make the most of its inherent variability (17).

A strength of this study, of showing the actual and effective provision of assistive products, and not only service availability, might also be one of its limitations, which it shares with other studies based on Brazilian health information systems. While providing real life information of a country-wide tax-based public healthcare system, the HIS on outpatient care used for this study was developed for administrative purposes and hence provides limited information for research purposes (18). Similarly, data presented here is entirely on provision, and does not necessarily reflect need, demand, or use of assistive technology in Brazil.

## **CONCLUSION**

Brazil has shown progress in improving assistive technology provision since the adoption of the CRPD and the 2011 National Disability Strategy which are largely due to pre-existing capacities and additional resources invested in its public healthcare system. Nevertheless, policymakers, managers and service providers still face many challenges to reduce the inequalities in resource distribution between the regions.

Strategic planning and implementation instruments, such as the upcoming Brazilian Assistive Technology Plan should take these study's findings into consideration, as well as additional information coming from the 2019 National Health Survey on use assistive products. With current restraints on resource availability to finance healthcare services and fundamental research efforts, such as the next national census, stakeholders need to make the most of existing data to improve assistive products provision while addressing baseline inequalities.

## DISCLOSURE STATEMENT

Authors declare that there is no conflict of interest

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**Table 1. Frequency of assistive products provided in Brazil between 2008 and 2019**

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Provided per year	426967	496631	592463	551067	562984	559726	659906	610339	619197	629171	693911	707048
Cumulative quantity	NA	923598	1516061	2067128	2630112	3189838	3849744	4460083	5079280	5708451	6402362	7109410
3-Year moving mean	NA	NA	505353,7	546720,3	568838	557925,7	594205,3	609990,3	629814	619569	647426,3	676710

Table 02. Changes in the frequency of assistive products provided in Brazil between 2008-2010 and 2017-2019 per Brazilian state.

UF	Mobility aids				Orthotics and prosthetics				Hearing aids				Visual aids			
	08-10	17-19	DIF (n)	DIF (%)	08-10	17-19	DIF (n)	DIF (%)	08-10	17-19	DIF (n)	DIF (%)	08-10	17-19	DIF (n)	DIF (%)
RO	4134,7	12290,7	<b>8156,0</b>	<b>197,3</b>	890,7	1311,3	<b>420,7</b>	<b>47,2</b>	2000,3	3882,0	<b>1881,7</b>	<b>94,1</b>	2,0	0,0	<b>-2,0</b>	<b>-100,0</b>
AC	1317,0	707,7	<b>-609,3</b>	<b>-46,3</b>	815,3	735,0	<b>-80,3</b>	<b>-9,9</b>	0,0	1380,7	<b>1380,7</b>		339,0	0,0	<b>-339,0</b>	<b>-100,0</b>
AM	234,0	301,7	<b>67,7</b>	<b>28,9</b>	35,0	326,3	<b>291,3</b>	<b>832,4</b>	80,0	2898,7	<b>2818,7</b>	<b>3523,3</b>	0,0	218,3	<b>218,3</b>	
RR	0,0	496,7	<b>496,7</b>		0,0	1,0	<b>1,0</b>		0,0	0,0	<b>0,0</b>	<b>0,0</b>	2799,7	0,0	<b>-2799,7</b>	<b>-100,0</b>
PA	719,7	1637,3	<b>917,7</b>	<b>127,5</b>	204,0	451,7	<b>247,7</b>	<b>121,4</b>	1786,3	3897,7	<b>2111,3</b>	<b>118,2</b>	3216,3	596,0	<b>-2620,3</b>	<b>-81,5</b>
AP	83,0	730,0	<b>647,0</b>	<b>779,5</b>	75,3	407,7	<b>332,3</b>	<b>441,2</b>	0,0	469,3	<b>469,3</b>		315,7	0,0	<b>-315,7</b>	<b>-100,0</b>
TO	547,0	251,7	<b>-295,3</b>	<b>-54,0</b>	200,3	37,7	<b>-162,7</b>	<b>-81,2</b>	806,0	708,3	<b>-97,7</b>	<b>-12,1</b>	511,3	0,0	<b>-511,3</b>	<b>-100,0</b>
MA	2061,7	2008,0	<b>-53,7</b>	<b>-2,6</b>	1729,3	1290,3	<b>-439,0</b>	<b>-25,4</b>	4207,7	3915,0	<b>-292,7</b>	<b>-7,0</b>	0,0	0,0	<b>0,0</b>	<b>0,0</b>
PI	948,3	9304,3	<b>8356,0</b>	<b>881,1</b>	838,7	2332,7	<b>1494,0</b>	<b>178,1</b>	2436,3	3874,7	<b>1438,3</b>	<b>59,0</b>	28328,3	1850,7	<b>-26477,7</b>	<b>-93,5</b>
CE	1715,0	1609,7	<b>-105,3</b>	<b>-6,1</b>	1702,0	1041,3	<b>-660,7</b>	<b>-38,8</b>	3767,7	3910,3	<b>142,7</b>	<b>3,8</b>	11065,7	2346,0	<b>-8719,7</b>	<b>-78,8</b>
RN	0,0	700,7	<b>700,7</b>		0,0	324,0	<b>324,0</b>		2408,3	2929,7	<b>521,3</b>	<b>21,6</b>	4810,3	29,0	<b>-4781,3</b>	<b>-99,4</b>
PB	878,0	230,7	<b>-647,3</b>	<b>-73,7</b>	487,3	83,0	<b>-404,3</b>	<b>-83,0</b>	1839,0	1812,7	<b>-26,3</b>	<b>-1,4</b>	33766,0	123,3	<b>-33642,7</b>	<b>-99,6</b>
PE	2529,3	7122,7	<b>4593,3</b>	<b>181,6</b>	6298,0	14254,7	<b>7956,7</b>	<b>126,3</b>	7326,7	6511,3	<b>-815,3</b>	<b>-11,1</b>	573,7	1575,7	<b>1002,0</b>	<b>174,7</b>
AL	1918,3	7285,7	<b>5367,3</b>	<b>279,8</b>	755,0	2399,0	<b>1644,0</b>	<b>217,7</b>	3675,0	5914,7	<b>2239,7</b>	<b>60,9</b>	916,0	25,0	<b>-891,0</b>	<b>-97,3</b>
SE	0,0	0,0	<b>0,0</b>	<b>0,0</b>	0,0	0,0	<b>0,0</b>	<b>0,0</b>	749,0	1033,7	<b>284,7</b>	<b>38,0</b>	0,0	0,0	<b>0,0</b>	<b>0,0</b>
BA	10852,7	10843,3	<b>-9,3</b>	<b>-0,1</b>	4560,3	4731,0	<b>170,7</b>	<b>3,7</b>	8356,7	14476,0	<b>6119,3</b>	<b>73,2</b>	589,7	310,0	<b>-279,7</b>	<b>-47,4</b>
MG	10223,0	23282,0	<b>13059,0</b>	<b>127,7</b>	8474,0	12034,7	<b>3560,7</b>	<b>42,0</b>	28405,0	42937,7	<b>14532,7</b>	<b>51,2</b>	14537,0	1678,7	<b>-12858,3</b>	<b>-88,5</b>
ES	1359,0	3752,3	<b>2393,3</b>	<b>176,1</b>	626,0	1273,7	<b>647,7</b>	<b>103,5</b>	2727,0	6488,3	<b>3761,3</b>	<b>137,9</b>	1090,3	2021,0	<b>930,7</b>	<b>85,4</b>
RJ	9963,3	16835,3	<b>6872,0</b>	<b>69,0</b>	9448,0	8080,7	<b>-1367,3</b>	<b>-14,5</b>	12373,7	18408,3	<b>6034,7</b>	<b>48,8</b>	4993,0	8705,3	<b>3712,3</b>	<b>74,4</b>
SP	12023,3	47863,0	<b>35839,7</b>	<b>298,1</b>	12050,7	33972,0	<b>21921,3</b>	<b>181,9</b>	57873,7	78164,0	<b>20290,3</b>	<b>35,1</b>	5470,3	4793,0	<b>-677,3</b>	<b>-12,4</b>
PR	6812,7	13357,7	<b>6545,0</b>	<b>96,1</b>	6624,7	9282,3	<b>2657,7</b>	<b>40,1</b>	15269,3	22707,7	<b>7438,3</b>	<b>48,7</b>	25304,3	17744,3	<b>-7560,0</b>	<b>-29,9</b>
SC	1087,7	1770,0	<b>682,3</b>	<b>62,7</b>	1751,0	2197,3	<b>446,3</b>	<b>25,5</b>	9101,7	17528,7	<b>8427,0</b>	<b>92,6</b>	858,0	459,7	<b>-398,3</b>	<b>-46,4</b>
RS	3519,0	14801,7	<b>11282,7</b>	<b>320,6</b>	4319,3	14584,7	<b>10265,3</b>	<b>237,7</b>	8938,3	30066,0	<b>21127,7</b>	<b>236,4</b>	335,3	5237,7	<b>4902,3</b>	<b>1461,9</b>
MS	617,0	5043,0	<b>4426,0</b>	<b>717,3</b>	377,7	2469,7	<b>2092,0</b>	<b>553,9</b>	7921,7	8013,0	<b>91,3</b>	<b>1,2</b>	553,0	380,7	<b>-172,3</b>	<b>-31,2</b>
MT	1653,3	1206,3	<b>-447,0</b>	<b>-27,0</b>	1060,3	207,7	<b>-852,7</b>	<b>-80,4</b>	2068,0	1050,3	<b>-1017,7</b>	<b>-49,2</b>	2446,0	148,7	<b>-2297,3</b>	<b>-93,9</b>
GO	11627,3	7623,3	<b>-4004,0</b>	<b>-34,4</b>	4427,0	5342,7	<b>915,7</b>	<b>20,7</b>	7284,3	18484,3	<b>11200,0</b>	<b>153,8</b>	73,7	900,0	<b>826,3</b>	<b>1121,7</b>
DF	5447,3	7468,3	<b>2021,0</b>	<b>37,1</b>	6670,0	3349,3	<b>-3320,7</b>	<b>-49,8</b>	2266,7	5056,3	<b>2789,7</b>	<b>123,1</b>	2,7	2,7	<b>0,0</b>	<b>0,0</b>

**Table 03. Changes in the frequency of administrative health regions covered by assistive products provision in Brazil between 2008-2010 and 2017-2019 per Brazilian state.**

UF	Total	Mobility aids						Orthotics and prosthetics						Hearing aids						Visual aids					
		08-10		17-19		DIF		08-10		17-19		DIF		08-10		17-19		DIF		08-10		17-19		DIF	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
RO	7	1	14,3	1	14,3	0	0,0	1	14,3	1	14,3	0	0,0	1	14,3	1	14,3	0	0,0	1	14,3	0	0,0	1	-14,3
AC	3	1	33,3	1	33,3	0	0,0	1	33,3	1	33,3	0	0,0	0	0,0	1	33,3	1	33,3	0	0,0	0	0,0	0	0,0
AM	9	1	11,1	1	11,1	0	0,0	1	11,1	1	11,1	0	0,0	0	0,0	1	11,1	1	11,1	0	0,0	0	0,0	0	0,0
RR	2	0	0,0	1	50,0	1	50,0	0	0,0	1	50,0	1	50,0	0	0,0	0	0,0	0	0,0	1	50,0	0	0,0	1	-50,0
PA	13	2	15,4	3	23,1	1	7,7	2	15,4	2	15,4	0	0,0	1	7,7	2	15,4	1	7,7	1	7,7	2	15,4	1	7,7
AP	3	1	33,3	1	33,3	0	0,0	1	33,3	1	33,3	0	0,0	0	0,0	1	33,3	1	33,3	1	33,3	0	0,0	1	-33,3
TO	8	2	25,0	2	25,0	0	0,0	1	12,5	1	12,5	0	0,0	1	12,5	2	25,0	1	12,5	2	25,0	0	0,0	2	-25,0
MA	19	1	5,3	2	10,5	1	5,3	1	5,3	2	10,5	1	5,3	2	10,5	3	15,8	1	5,3	0	0,0	0	0,0	0	0,0
PI	11	1	9,1	1	9,1	0	0,0	1	9,1	1	9,1	0	0,0	1	9,1	1	9,1	0	0,0	1	9,1	1	9,1	0	0,0
CE	22	2	9,1	3	13,6	1	4,5	2	9,1	2	9,1	0	0,0	4	18,2	2	9,1	2	-9,1	4	18,2	3	13,6	1	-4,5
RN	8	0	0,0	1	12,5	1	12,5	0	0,0	1	12,5	1	12,5	4	50,0	3	37,5	1	-12,5	0	0,0	1	12,5	1	12,5
PB	16	3	18,8	6	37,5	3	18,8	3	18,8	3	18,8	0	0,0	2	12,5	3	18,8	1	6,3	3	18,8	0	0,0	3	-18,8
PE	12	1	8,3	1	8,3	1	0,0	1	8,3	1	8,3	0	0,0	3	25,0	4	33,3	1	8,3	1	8,3	2	16,7	1	8,3
AL	10	2	20,0	3	30,0	1	10,0	2	20,0	2	20,0	0	0,0	2	20,0	2	20,0	0	0,0	1	10,0	1	10,0	0	0,0
SE	7	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	0	0,0	1	14,3	1	14,3	0	0,0	0	0,0	0	0,0	0	0,0
BA	28	6	21,4	7	25,0	1	3,6	5	17,9	6	21,4	1	3,6	3	10,7	6	21,4	3	10,7	1	3,6	1	3,6	0	0,0
MG	89	19	21,3	29	32,6	10	11,2	16	18,0	28	31,5	12	13,5	12	13,5	13	14,6	1	1,1	2	2,2	5	5,6	3	3,4
ES	3	1	33,3	2	66,7	1	33,3	1	33,3	3	100,0	2	66,7	1	33,3	1	33,3	0	0,0	1	33,3	1	33,3	0	0,0
RJ	9	2	22,2	2	22,2	0	0,0	2	22,2	3	33,3	1	11,1	4	44,4	4	44,4	0	0,0	1	11,1	2	22,2	1	11,1
SP	63	11	17,5	26	41,3	15	23,8	12	19,0	28	44,4	16	25,4	17	27,0	21	33,3	4	6,3	7	11,1	8	12,7	1	1,6
PR	22	15	68,2	20	90,9	5	22,7	16	72,7	18	81,8	2	9,1	12	54,5	12	54,5	0	0,0	19	86,4	16	72,7	3	-13,6
SC	16	3	18,8	6	37,5	3	18,8	3	18,8	3	18,8	0	0,0	5	31,3	4	25,0	1	-6,3	2	12,5	2	12,5	0	0,0
RS	30	8	26,7	11	36,7	3	10,0	8	26,7	11	36,7	3	10,0	6	20,0	10	33,3	4	13,3	2	6,7	5	16,7	3	10,0
MS	4	1	25,0	2	50,0	1	25,0	1	25,0	2	50,0	1	25,0	2	50,0	1	25,0	1	-25,0	1	25,0	2	50,0	1	25,0
MT	16	1	6,3	4	25,0	3	18,8	1	6,3	1	6,3	0	0,0	1	6,3	2	12,5	1	6,3	1	6,3	1	6,3	0	0,0
GO	18	1	5,6	2	11,1	1	5,6	1	5,6	2	11,1	1	5,6	1	5,6	2	11,1	1	5,6	0	0,0	1	5,6	1	5,6
DF	8	1	12,5	1	12,5	0	0,0	1	12,5	1	12,5	0	0,0	1	12,5	1	12,5	0	0,0	0	0,0	1	12,5	1	12,5