Deliver Hope for Survivors

By Abder Banoune [ Humanitarian & Inclusion ]

Humamity & Inclusion (HI) has been making prostheses and orthoses since its launch in refugee camps along the Thailand/Cambodia border in 1982, when it was known as Handicap International. The organization has since developed a global approach to disability, aiming to reduce poverty and situations of vulnerability, while working to ensure development and emergency responses are accessible to all. After nearly forty years of action, teams in fifty-five countries perform this critical work today.

At the Fourth Review Conference of the Anti-Personnel Mine Ban Convention (APMBC) in Oslo in November 2019, Ugandan conflict survivor Margaret Orech Arach had a predicament. She told her fellow landmine campaigners that she was in desperate need of a new prosthetic leg, having lost her right leg during an ambush in 1998. Her current artificial limb caused her pain and made walking difficult. Yet despite being Ambassador for the International Campaign to Ban Landmines (ICBL), she was finding it difficult to obtain a new prosthesis.

Meanwhile, in Syria, two men were recovering from landmine accidents, with doctors needing to amputate a limb in each case. Mohamed was twenty-five years old when he encountered a landmine in 2015. And Zidan, a shepherd, was just eighteen when he grazed his cattle in an area that he didn’t know was mined. Zidan’s father had previously died, leaving him responsible for the family’s income. The effects of his injury would ricochet throughout his family.

The year 2019, the last year for which we have explosive ordnance (EO) casualty data, saw more than 5,550 people killed or injured by mines/explosive remnants of war (ERW). Of that total, at least 2,170 people died, and another 3,357 were injured.¹ The majority of people who survive an EO accident acquire life-changing injuries, with a large number of these survivors requiring rehabilitation and prostheses. Yet access to both remains severely limited. An estimated 80 percent of persons with disabilities live in developing countries. However, only 5–15 percent of people living in low- and middle-income countries who require assistive devices and technologies can access them. What’s more, in low-income countries, rehabilitation services are often under-resourced and undeveloped. This is compounded in areas experiencing conflict. Poorly made or unadjusted prostheses can cause skin sores, pressure wounds, and muscle fatigue.

According to the Global Burden of Disease Study 2019, more than one-third of the world population, 2.4 billion people², would benefit from rehabilitation. Rehabilitation for persons with disabilities, among them EO survivors, requires adapted and accessible infrastructure, specialized care-providers, trained rehabilitation professionals, long-term interventions, and financial resources. Even when services are available, the most marginalized populations can rarely afford them. Poverty, stigma, and discrimination, as well as inaccessible information and infrastructure, combine to create what seem like insurmountable barriers for people with disabilities.

The gap between needs and available services is enormous. It limits an individual’s ability to reach and maintain functioning capacity, participate in education, find decent work, and become an active member of society.

According to the Global Burden of Disease Study 2019, more than one-third of the world population, 2.4 billion people², would benefit from rehabilitation.
of society. A recent study by ATscale demonstrates that funding of four assistive products—hearing aids, prostheses, eyeglasses, and wheelchairs—would result in a nine-to-one return on investment.

HI has been making prostheses and orthoses since its launch in refugee camps along the Thailand/Cambodia border in 1982, when it was known as Handicap International. At that time, HI was the first humanitarian organization to meet emergency orthopedic needs. By setting up orthopedic centers and training competent local teams, HI used simple, locally-available equipment to provide immediate, effective, and practical services that met emergency orthopedic needs of thousands of EO survivors in need of a prosthetic limb, including many amputee survivors of anti-personnel mines. The organization has since developed a global approach to disability, aiming to reduce poverty and situations of vulnerability, while working to ensure development and emergency responses are accessible to all. After nearly forty years of action, teams in fifty-five countries perform this critical work today. Over decades of experience, often with support from agencies like USAID and the U.S. Department of State’s Bureau of Population, Refugees and Migration, teams have provided a range of rehabilitation services and trained local staff to provide quality care. Donor support has helped establish rehabilitation centers in dozens of countries, including Cambodia, Haiti, and Nepal, where USAID opened new clinics and provided professional training after the 2010 earthquake. Additionally, similar funding provided specialized care to people injured after the Nepal earthquake. Syrian refugees in Jordan and Lebanon, and refugees living in Kenya’s Dadaab and Kakuma camps have also benefited from such care. The Office of Weapons Removal and Abatement in the U.S. State Department’s Bureau of Political-Military Affairs (PM/WRA), as well as many other donors—the European Union, the Norwegian MFA, Australian Department of Foreign Affairs and Trade, Germany, and others—have contributed funding for victim assistance (VA) as part of broader mine action budgets to support the provision of rehabilitation and other services. In many countries, VA efforts have launched a national disability dynamic and supported the delivery of vital services for EO survivors and other persons with disabilities.

Even with dedicated donors and partnerships, however, the needs still outweigh the services that one international nongovernmental organization (INGO) using traditional methods can produce.

Geraldo (age six) shows off his new 3D-printed splint that he received from the HI rehabilitation center in Lomé, Togo. The splint will help to correct his right ankle. Image courtesy of Philippa Poussereau/Hi.
In 2016, the African Federation of Rehabilitation Professionals (FATO) met in Lomé, Togo, where Isabelle Urseau, Director of HI’s Rehabilitation Division, shared the results of a trial using digital technologies, including 3D printing, to provide physical rehabilitation and assistive support services.

The potential for digital technologies to transform the rehabilitation sector had been on Urseau’s mind for years. She pitched the concept to HI’s directors in 2014, unlocking EUR 70,000 of the organization’s innovation funds from private donors.

Since then, Urseau’s teams have worked closely with private stakeholders, universities, research institutes, and local professional associations to put their hypothesis to the test: Digitalization combined with additional production could improve access to rehabilitation care and assistive devices for people with EO and other conflict-related injuries, including landmine survivors, as well as others with mobility issues. HI’s teams facilitate access and provide services ranging from mental health and psychosocial support to rehabilitation and inclusive education, as well as social and economic inclusion to survivors and other persons with disabilities alike. In 2019, HI’s beneficiaries included at least 9,965 survivors of landmines or explosive weapons.

The next phases of the project benefited from a range of partnerships and funding. The Directorate-General for Development Cooperation and Humanitarian Aid of Belgium, the UK’s Foreign, Commonwealth & Development office, and Agence Française de Développement (AFD) all pitched in. To date, HI has piloted 3D-prosthetic and -orthotic printing projects in six contexts: Madagascar, Mali, Niger, Syrian crisis-affected countries, Togo, and Uganda. In 2019 alone, the Syrian crisis response team

Digital Transformation

An orthosis stands on a table at the HI printing facility on June 6, 2018, in Lomé, Togo. HI, as part of the IMPACTE 3D project, is using 3D technology in a clinical trial to build dedicated orthoses for one hundred patients in Mali, Niger, and Togo.

Orthoprosthetist Mathieu Afetse (R) and printing technician Fabrice Djodji (L) check a 3D printer as it prints an orthosis at the HI facility in Lomé, Togo.

Image courtesy of Xaume Olleros/HI.
saw 3,462 people with injuries caused by explosive weapons used in populated areas and 801 people affected by EO. Teams use small, lightweight 3D scanners to create digital molds of body parts, make adaptations according to the patients’ needs using computer-modeling software, and then send it to the 3D printers. The printers create thousands of layers of thermoplastic to produce bespoke sockets that fit patients’ limbs.

This work is part of what’s now known as the Telerehabilitation for All (TeReFa) initiative, providing complete rehabilitation services in post-conflict settings, in support of refugees fleeing conflict, and other underserved areas through local health partners, mobile teams, remote experts via telemedicine, and now technologies such as 3D printing to deliver orthopedic devices. The result is a digital ecosystem that is transforming the delivery of health care services.

As a part of the TeReFa initiative, HI conducted studies in different contexts—emergency, EO-contaminated conflict settings, development, and refugee camps—focusing on technological, clinical, and social aspects for patients and professionals. The results indicated that access to rehabilitation, prosthetic, and orthotic services increases physical independence, reduces vulnerability, mitigates the risk of exclusion, and contributes to improved quality of life. Products were able to meet patient expectations; requiring less time to customize 3D-printed devices that meet structural and mechanical needs; and reducing the need for infrastructure, equipment, and human resources to produce conventional prostheses and orthoses. Moreover, telerehabilitation compensates for the shortage of professionals on-site/in-country and improves communication by bringing qualified specialists closer to users who are accompanied by on-location health workers.

Nevertheless, difficulties remain: While 3D printing and telerehabilitation break down some of the barriers to rehabilitation in low- and middle-income settings, the price is comparable. In 2017, HI published “Pilot Testing of 3D Printing Technology for Transtibial Prosthesis in Complex Contexts (Togo, Madagascar, and Syria responses),” which demonstrated that there is a limited cost difference between the conventional production and 3D printing of orthopedic devices.

A shortage of qualified specialists poses another challenge. The World Health Organization (WHO) indicates that in many low- to middle-income countries, the density of skilled practitioners is below ten per one million population. The number of other health professionals who can deliver rehabilitation services is also extremely low. In Africa, Southeast Asia, and Western Pacific, the number of practicing prosthetic and orthotic specialists is less than one-tenth of the number required; there should be at least five prosthetic and orthotic professionals for every one million people.

The project has since expanded. So far, 234 people have received rehabilitation as well as orthoses or prostheses through the pilot phases (150 people received orthoses, and 84 people received prostheses), including Margaret, Mohamed, and Zidan, who each received 3D-printed devices and rehabilitation services through HI’s 3D Printing Through Emergency Tele Rehab Access project (PETRA).
From Bamboo to 3D Printing:

Evolution of Rehabilitative Care and Services to Survivors of Conflict

By Isabelle Urseau

In my 35-year career at Humanity & Inclusion, I’ve witnessed an evolution in rehabilitative technology, the services we provide, and how we structure them. In working with landslide survivors in Colombia, people living with long-term disabilities caused by leprosy or polio in India, and mine survivors in Mozambique, HI’s goal has been to identify problems and find solutions.

Early on, rehabilitation was sometimes the only service HI provided to communities in the wake of emergencies or conflicts. But we recognized that wasn’t enough. You can help a person strengthen their muscles, manage phantom pains, and learn to walk again with the help of a prosthesis, but the work should not end there. While people may be living with different injuries or disabilities, their needs were almost always the same: calling for a continuity of early care and a comprehensive approach of rehabilitation, psychosocial support, and inclusive education and/or employment. This is especially true in conflict-affected regions, where psychological trauma is compounded by insecurity, poverty, and a constant fear of losing life or limb from landmines and other explosive devices.

Over time, HI has developed effective, comprehensive health and rehabilitative practices, adopting a holistic approach meant to last long into the future. Providing rehabilitation, mental health, and social services was a start, but teams now ensure children with disabilities attend accessible schools and that entrepreneurs living with permanent injuries can maintain thriving businesses. HI also advocates for improved policies to create sustainable change. For example, HI’s work in Nepal started in response to conflict, shifted to crisis mode after the 2015 earthquake, and is now focused on development supported by an established network of government actors, social services, and NGOs.

Similarly, HI’s rehabilitation efforts and buy-in from stakeholders and institutes such as the WHO have evolved. In 1991, toward the end of Mozambique’s fifteen-year conflict, I began working with mine survivors. At that time, we used locally-available materials to build orthoses and prostheses. I trained local technicians to construct assistive devices out of bamboo, leather, wood, and iron—materials we knew they could source locally—and collaborated with other institutions to import materials to produce low-cost, plastic orthoses and prostheses. In the face of emergencies, such as the earthquake in Haiti and the ongoing Syrian crisis, HI implemented emergency programs, providing people temporary prostheses that were later replaced with permanent ones once services were more established.

Fast forward to 2014, when we began workshopping the ideas of telerehabilitation and 3D printing to better serve people in isolated areas. Our goals were to improve communication, while cutting costs and transportation times. People were dubious at first, but in a world of emerging technology, testing and experimentation are essential, as are agility, frugality, and flexibility in conflict-affected regions.

When the COVID-19 pandemic hit, HI was able to expand existing telerehabilitation and 3D-printing programs to continue serving communities without interruption. As of mid-2021, we’ve fitted 250 people with 3D-printed orthoses and prostheses through our pilot projects in Africa, produced 3D-printed personal protective equipment, and conducted thousands of telerehabilitation sessions.

What remains universal is the need to work together to identify multiple solutions that answer specific needs and demands, while building sustainable capacity of local communities over time. What has changed is the digital transformation of rehabilitative care—including telerehabilitation and 3D printing—that enables users and local communities the opportunity to access care and respond quickly to individual needs.”
Tabita is an eleven-year-old girl from South Sudan who now lives in Omugo refugee camp in Uganda with her family. When she was three years old, Tabita contracted polio, causing her legs to become noticeably weak. Unable to stand without support, she began using crutches to help her walk around the camp and go to school. The HI team helped Tabita with her mobility aids, which eased access to her school and gave her greater freedom to socialize with her friends. A psychosocial worker of the CRHR and Education Cannot Wait projects is working with Tabita and her family, helping her to manage her disability and strengthen her self-esteem. Images courtesy of Quinn Neely.

Tabita is assessed for the 3D Project for a knee-foot-ankle orthosis to support her lower limbs.

Tabita with friends and family in the Omugo refugee camp in Uganda.
In 2020, the European Union recognized HI, awarding the organization with a Horizon Prize for two innovations in humanitarian mine action and beyond, namely its 3D-printing innovation that represents an evolution in VA and its drone technology that greatly speeds up safe EO impact survey efforts.

In regards to the 3D-printing technology, HI’s technical experts are currently working to lower production costs. They’ve teamed up with the French National Institute for Applied Sciences (INSA) to test locally-sourced, recycled materials to produce prostheses and orthoses. Meanwhile, staff in Vietnam, thanks to USAID funding, are developing a new app to virtually connect rehabilitation professionals with patients, optimizing the transition of care from hospital to home and improving family-based, follow-up care. All of these digital initiatives should reinforce the organization’s capacity to reach more beneficiaries and improve their rehabilitation care.

In the coming years, HI staff will focus on scaling the technology and making it more sustainable. Plans include launching five regional hubs associated with local networks of rehabilitation centers and professionals, and ensuring proper technology transfer to our partners. Advocacy efforts to include rehabilitation services in eHealth strategies, and integration of assistive technology solutions in universal health coverage will be key activities to ensure the approach is adopted widely.

But for now, staff take great pride in the wins celebrated by Margaret, who should be back on the road advocating post-COVID; Mohamed, who has found work at home in Syria; and Zidan, who is once again tending his cattle and helping to keep his family afloat.

As of today, thirty-four States Parties of the APMBC have reported a responsibility for a significant number of EO survivors within their national territory, and twelve States Parties of the Convention on Cluster Munitions have reported the same for cluster munition survivors. In addition, evidence show that mine and cluster munition casualties have been identified in other states and regions.

By adopting the Oslo Action Plan (OAP) in 2019, States Parties of the APMBC have renewed their commitment to assist mine survivors, including providing rehabilitation services. In particular, the OAP notes the need to “take steps to ensure that, taking into account local, national and regional circumstances, all mine victims, including in rural and remote areas, have access to comprehensive rehabilitation services [...] this includes the provision of assistive devices, physiotherapy, occupational therapy and peer-to-peer support programs.” VA efforts and the provision of rehabilitation services is a continuous process that will allow us to advance toward an inclusive society where all persons with disabilities, including EO survivors, enjoy their human rights.

**What’s Next?**

In Uganda, HI adapted 3D-printing technology to produce protective face visors for the COVID-19 pandemic. Image courtesy of Philippa Poussereau/HI.

**Abder Banoune**

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Based in Lyon, France, Abder Banoune has seventeen years of field experience with expertise in prosthetic and orthotic technology, and project management. After graduate studies in Algeria toward a career as an orthotist with a specialty in physical rehabilitation, he joined Humanity & Inclusion in 2001 as a P&O Technical Advisor, working in China and Yemen. From 2005 to 2018, Banoune worked with the International Committee of the Red Cross (ICRC), holding a variety of roles, including Physical Rehabilitation Project Manager, working in Ethiopia, Niger, Malawi, South Sudan, and Sudan. He completed a master’s degree in Management of Health and Social Services within the Business Administration School (ESCAE, Niamey), as well as a Certificate in Advanced Training in Leadership Management and Governance (Yale University School of Public Health). Banoune speaks French, English, and several Arabic dialects.
ENDNOTES

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6. As it is shown by the *Landmine and Cluster Munition* Reports 2020, over the previous year casualties from cluster munition attacks were reported in Syria and Libya, while casualties due to cluster munition remnants were recorded in ten countries and other areas: Afghanistan, Iraq, Lao PDR, Lebanon, Serbia, South Sudan, Syria, and Yemen, as well as Nagorno-Karabakh and Western Sahara. Similarly, mine casualties in 2019 were identified in fifty-five states and other areas, of which thirty-six are States Parties to the Mine Ban Treaty.