It’s hard to imagine how someone with a spinal cord injury who has lost the ability to walk must feel when, assisted by an exoskeleton—a robotic suit that supports their weight and helps moves their limbs for them—they are returned some of their former mobility. Advances in this field have been spectacular. The bulky, body-enveloping suits of just a few years ago (akin to the cargo-lifting exoskeletons worn by characters in films such as Alien and Avatar) are being replaced by more lightweight, more agile, more usable, more human designs: those commercially available today are far more sleek than the heavy exoskeleton showcased at the 2014 FIFA World Cup. But now imagine an even more discrete system that provides powered postural assistance to patients with, say, multiple sclerosis. Imagine a robotic arm orthosis that cancels out tremors in people with Parkinson’s disease, or a small wearable machine that helps retrain the brain to coordinate movement. Imagine a hardly noticeable soft suit of straps and thin cables providing powered gait correction to stroke survivors or children with cerebral palsy. All these things and more are being developed and could soon be part of our rehabilitation and home care arsenal. The battle to bring new exoskeletons out of the cupboard is on.

And developers can smell success. At the World Congress of the American Orthotic and Prosthetic Association (Las Vegas, NV, USA, September, 2017), the talk was of a market worth perhaps US$1.8 billion by 2025—now just 7 years away—and of over 100 000 robotic exoskeletons sold and in use by then. However, obstacles to bringing out a new generation of exoskeletons for use by patients with neurological conditions other than spinal cord injury still exist. Designs need to be perfected, especially if they are to move out from the controlled confines of the rehabilitation unit and into patients’ homes. In addition, evidence needs to be gathered to confirm their benefits, licensing approvals granted, and so on. So, when might we see these devices available?

“Designs for spinal cord injury for rehabilitation and home and community use, and a soft suit for stroke rehabilitation, are ready and do not need further development”, explains Larry Jasinski, CEO of ReWalk Robotics (Marlborough, MA, USA). “[But those] for multiple sclerosis, Parkinson’s disease, a home or community version of a [stroke assistance device], and products to assist the elderly are at concept stages and require refinement, testing, and further studies. Most of these require 2-4 years of funding and development, but are based on existing technical concepts that can be built upon.”

“As a field, we have made good progress on the engineering front”, says Ashish Deshpande, Associate Professor of Mechanical Engineering at the University of Texas at Austin (Austin, TX, USA), whose group is perfecting an exoskeleton for use in the rehabilitation of patients with stroke and brain injury. “Designs are becoming more compact, devices are becoming safer and more comfortable, and algorithms are being developed to allow for subject-specific assistance. There is still some way to go, however, in terms of lowering the weight and attaining seamless interaction with the user.”

Benny Lo and his team at Imperial College London (London, UK), who are working on an arm-worn exoskeleton to correct tremors in patients with Parkinson’s disease, also need time to perfect their potentially quality of life-changing device. “We have a working prototype, but it still requires much more development in terms of optimising the design, reducing the weight, extending battery life, etc, before we can start subject or clinical studies”, he explains.

“We started working on developing exosuit [ie, soft suit] technology in 2012, initially with the goal of helping healthy people walk with less effort and, in 2014, began exploring the possibility of adapting the technology for patients with post-stroke difficulties”, explains Conor Walsh, head of the Harvard Biodesign Laboratory (Harvard University, Boston, MA, USA). “Post-stroke gait is characterised by asymmetric and inefficient walking, and we felt that an exosuit could help restore the function of the impaired limb. The suit is attached to the wearer’s legs via straps. Light-weight cables connected at the ankle joint and operated by motors, pulleys, and batteries worn around the waist help to support patient movement. “We have shown that the exosuit can supplement the paretic limb’s residual ability to generate forward propulsion and ground clearance during walking, and that may help a person to train to achieve a more normal walking behaviour after stroke”, says Walsh. “Delivering small amounts of active assistance through this lightweight and non-restrictive interface could have a positive effect on the mobility of people with physical impairments.” It is hoped that a productised version will begin trials later this year.

But are such trials really necessary? Can we not simply see that an exoskeleton works and go straight
Will exoskeletons for patients with neurological disorders be a common sight?

For more on the use of exoskeletons for people with spinal cord injury see
Medical Devices: Evidence and Research; 2016; 9: 455-66
For more on FDA approvals and risk-benefit decisions see JAMA 2017; 317: 693-94
For the approval of medical devices in the EU see https://ec.europa.eu/growth/sectors/medical-devices/regulatory-framework_en#current_guidance
For the approval of medical devices in the UK see https://www.nice.org.uk/About/What-we-do/Our-Programmes/NICE-guidance
NICE-medical-technologies-guidance
For more on the difficulties of insurers covering the costs for exoskeletons see http://www.modernhealthcare.com/article/20161126/MAGAZINE/31126002/2/why-cant-devicemakers-and-insurers-get-along
For the Vanderbilt developed at Vanderbilt University see https://news.vanderbilt.edu/2016/03/10/fda-approves-vanderbilt-designed-indego-exoskeleton-for-clinical-and-personal-use

For more on the use of exoskeletons for people with neurological disorders see
For the approval of medical devices in the EU see https://ec.europa.eu/growth/sectors/medical-devices/regulatory-framework_en#current_guidance
For the approval of medical devices in the UK see https://www.nice.org.uk/About/What-we-do/Our-Programmes/NICE-guidance
NICE-medical-technologies-guidance
For more on the difficulties of insurers covering the costs for exoskeletons see http://www.modernhealthcare.com/article/20161126/MAGAZINE/31126002/2/why-cant-devicemakers-and-insurers-get-along
For the Vanderbilt developed at Vanderbilt University see https://news.vanderbilt.edu/2016/03/10/fda-approves-vanderbilt-designed-indego-exoskeleton-for-clinical-and-personal-use

The Ebola virus and the response to it by the world’s health organisations, is the focus of the article. The article highlights the challenges faced by health care providers and the lessons learned from the outbreak. The article also discusses the role of technology in the response to the outbreak, and the need for continued investment in research and development of new treatments and vaccines.

The article is published in the journal *The Lancet* and is available online. The article is also available in English and French.

For more information, please contact the author or the author’s institution.

Adrian Burton