



Upper-Limb Orthotic Devices

Out of the Clinic, Into the Home



More than 1 million Americans can move their arms, but not sufficiently. Many have neuromuscular disorders that impair their ability to move against gravity, hinder their activities of daily living, and challenge their participation in society.

Fortunately, patient outlook is improving due to:

- New research discoveries in upper-limb function and in reablement
- Advances in wearable assistive devices

1930s

Upper-limb assistive devices first developed in response to polio ¹

1945

Patent filed for first myoelectric-powered orthosis ²

1948
American Board of Certification begins to certify prosthetists and orthotists

1960s

Upper-limb assistive technologies expand and integrate into the standard of care for capital equipment

1963

Katz, etc. publish Index of Independence in Activities of Daily Living (ADLs) ³

1969

Lawton, etc. publish Instrumental Activities of Daily Living ⁴

1990s

Average stay of acute SCI rehab shrinks to 44 days from 145 days two decades earlier. The time available to introduce arm assist devices and provide training becomes insufficient ⁵

2006

First study connecting ADLs to upper-limb assistive technologies ⁶

2020

Essers, etc. finds that most prevalent users of upper-limb orthoses now use their device 17 hours/day on average ⁷

Today

Today — Modern devices feature:



Lightweight materials
(carbon fiber, etc.)



Advanced sensors
and microprocessors

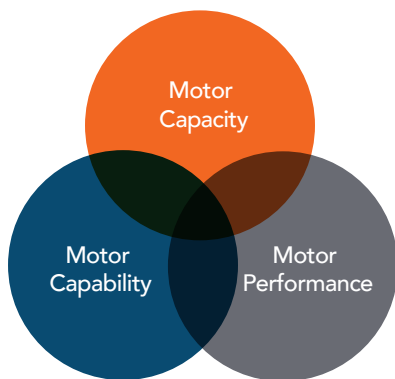


High-density
batteries



Powerful
actuation systems

The World Health Organization gives a framework for situations relating to human functioning and its restrictions. Researchers have additionally noted important contextual differences for where the activities are performed and have devised three constructs:⁸



What patients can do in standardized environments

Controlled, supervised clinical settings

What patients can do in their daily environment

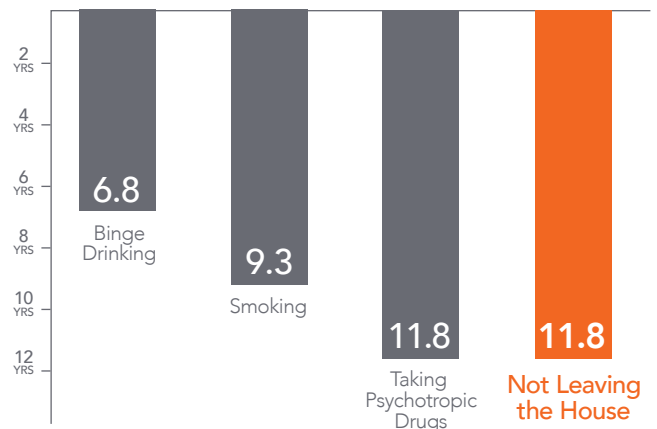
Account for physical barriers

What patients actually do in their daily environment

Account for emotional and social barriers

Recent Research⁹

Lost Years for SCI Patients Due to Certain Behaviors:

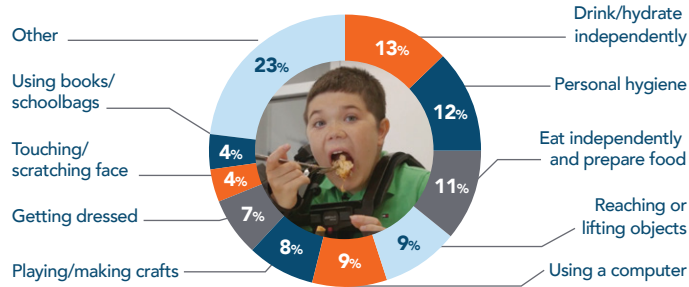


“ It is important to fully consider environmental and personal factors... to optimize not only what the (individual) can do in a controlled environment but also what he/she can and does do in his/her daily environment. ”

Patient Population Example: Upper-Limb Function Becomes Top Priority for DMD Patients¹⁰

In 2007, the Dutch Duchenne Parent Project found that young men with Duchenne Muscular Dystrophy (DMD) consider upper-limb function preservation to be of the highest priority.

This was confirmed by a 2015 global study of DMD patients that found the activities that caused the most problems in daily life due to upper extremity impairments were:



Financial Factors

Caregiver Shortages



- Growth in Demand for Caregivers, 2018-2028: **36%**¹¹
- Anticipated Turnover Across Long-Term Care Sector: **45-66%**¹²
- Expected Shortfall of U.S. Caregivers by 2026: **7.8M**¹³

Financial Constraints



- Semi-Private Bed in Nursing Home: **\$90,156**¹⁴
- **1 in 3 people** leave the workforce and forego their income to care for a family member with a disability¹⁵

A 5-year study¹⁶ in Australia of adults receiving reablement (home-based care focused on improving functioning in daily activities valued by the patient) versus conventional home-based care found they:



Used fewer home care hours and incurred lower total home care costs



Were less likely to be admitted to emergency care



Were less likely to transition to higher levels of care



Were less likely to have unplanned hospital admissions



Assessments for upper-limb devices can begin with confidential, virtual evaluations and involve:

- Inquiries into Medical Need
- Range of Motion Evaluation
- Strength Evaluation
- Quality of Life Goals (Activities of Daily Living, etc.)
- Inquiries into Caregiver Support

Key questions for patients considering these technologies:

- Is the device meant for rehabilitation or Activities of Daily Living?
- Can it assist with bilateral as well as unilateral tasks?
- Is it designed for ambulatory or non-ambulatory patients?
- How easy is it to don or doff, and how often must it be calibrated?
- Does the technology support intuitive movement?
- Which parts of the arm (shoulder, elbow, wrist) can it assist?
- Can it support varying levels of weight, and what is entailed?



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