# Intense rehabilitation therapy produces very large gains in chronic stroke

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## A Call to Arm Rehabilitation to End Neuro-Nihilism

Stroke is among the top three causes of disability in our species. Motor deficits are the most common problem after stroke and a major contributor to this disability. Activity-based training (e.g., physical therapy or occupational therapy) can improve behavioural outcomes, with meta-analysis suggesting that higher doses of activity-based therapy targeting the motor system improve behavioural outcomes after stroke.[1] However, many patients do not receive high doses of rehabilitation therapy after stroke, for reasons that include economic factors, access, and a paucity of data to guide decision-making regarding therapy intensity.

In this context, Ward et al[2] examined whether providing patients with a very large dose of rehabilitation therapy produces enduring gains in motor function, with critically important results. These authors enrolled 224 patients in the chronic phase of stroke (median 18 months post-stroke). Entry criteria were intentionally broad: stroke survivors were eligible if they had a weak (but not paralyzed) arm and were excluded if pain, spasticity, or medical conditions were severe. Each received 90 hours of therapy over 3-weeks, consisting of an individualized program of occupational therapy and physical therapy that aimed to reduce impairment and improve activities of daily living through improved motor control.

All patients completed the 3-week programme, with no adverse events reported. Statistically significant and clinically important motor gains were found for all four co-primary arm motor outcome measures. For example, the Action Research Arm Test (ARAT) score increased by a median of 6 points from pre-therapy to post-therapy (minimal clinically important difference=5.7 points). Critically, behavioural gains not only persisted after end of therapy but also continued to grow. By 6 months post-therapy, ARAT had increased 2 more points and gains exceeded the minimal clinically important difference in 61.6% of patients.

Behavioural gains in this study were high, comparing quite favourably with any published data in the history of stroke recovery research. Other strengths of the study include its very large size and enrolment of patients with wide-ranging motor deficits. The study is limited by the absence of a control group, although arm function generally plateaus by 3 months post-stroke. Enrollees (median age 52) were young for stroke, and global functional status was very good (median Barthel Index score of 19 out of 20), suggesting uncertainty as to how results will generalise to patients with severe global deficits.

These positive results will forever change how research into activity-based training after stroke is dosed: 90 hours of therapy improves arm function while 32 hours[3] does not. Results suggest the need for a health economic analysis. In this regard, telehealth methods might be able to efficiently extend application of these results.[4] Stroke is not a 'one-size-fits-all' target, and so the target population that responds best to this intervention should be defined. Ward *et al* found baseline behaviour to be a useful predictor, but direct measures of neural injury and neural function are powerful predictors of treatment response in patients with chronic stroke and often outperform behavioural assessments.[5]

We owe it to our patients to provide therapies that substantially improve functional status. The nihilistic view that chronic stroke is a condition that cannot be improved with therapy is no longer tenable. The question is not whether we can substantially improve function in a majority of our patients, but rather what is the best pathway to deliver this care.

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## REFERENCES

1. Lohse KR, Lang CE, Boyd LA. Is more better? Using metadata to explore dose-response relationships in stroke rehabilitation. *Stroke* 2014;45:2053–8.
2. Ward NS, Brander F, Kelly K. Intensive upper limb neurorehabilitation in chronic stroke: outcomes from the Queen Square programme. *J Neurol Neurosurg Psychiatry* 2019;90:498–506.
3. Lang CE, Strube MJ, Bland MD, *et al*. Dose response of task-specific upper limb training in people at least 6 months poststroke: a phase II, single-blind, randomized, controlled trial. *Ann Neurol* 2016;80:342–54.
4. Dodakian L, McKenzie AL, Le V, *et al*. A home-based telerehabilitation program for patients with stroke. *Neurorehabil Neural Repair* 2017;31:923–33.
5. Burke Quinlan E, Dodakian L, See J, *et al*. Neural function, injury, and stroke subtype predict treatment gains after stroke. *Ann Neurol* 2015;77:132–45.