

Neuro-Rehabilitation OnLine (N-ROL): description and evaluation of a group-based telerehabilitation programme for acquired brain injury

Intense rehabilitation after stroke and other forms of acquired brain injury (ABI) can lead to large clinical improvements.¹⁻³ The arrival of COVID-19 in early 2020 influenced stroke presentations⁴ but reduced opportunities for rehabilitation.⁵ The necessity to avoid face-to-face contact and to reach as many patients with as few staff as possible led to a three-way collaboration between University College London, University College London Hospitals NHS Foundation Trust (UCLH) and SameYou charity to set up a comprehensive, multidisciplinary group-based Neuro-Rehabilitation OnLine (N-ROL) programme. N-ROL involved physiotherapy, occupational therapy, speech and language therapy, neuropsychology and neurology. Here we describe N-ROL (Template for Intervention Description and Replication (TIDieR) checklist, online supplemental table S1) and report our quantitative evaluation. N-ROL is registered with UCLH Quality and Service Department as a service evaluation (reference number 55-202021-SE).

Patients were referred by community or hospital-based rehabilitation teams and screened via telephone. Inclusion criteria included confirmed ABI, <6 months from hospital discharge, English speaking and willingness to engage in online group-based sessions. Exclusion criteria included no access to computer hardware. Triage into specific groups was carried out in the same call if participants were suitable and refined in an initial 'meet the team' group session. There was no limit to the number or type of sessions individuals could take part in, although the number of participants per session was capped for some groups (online supplemental table S2).

Assessments were completed immediately before and after completion of N-ROL in a repeated-measures design. We expected that most patients would participate in a range of groups through which their knowledge and confidence to pursue recovery would be enhanced. Rather than use limited resources on domain-specific outcome measures, we therefore wanted to test the efficacy of N-ROL as a whole. Our first outcome measure was the Stroke Self-Efficacy Questionnaire (SSEQ), a Likert scale (0-3) questionnaire with 13

questions with good criterion validity.⁶ Our second outcome measure, Neuro-Rehabilitation OnLine Outcome Measure (N-ROLOM), a novel Likert scale¹⁻⁵ questionnaire with seven questions for patients and two for carers/family (online supplemental appendix). The questions were constructed from themes derived from semistructured interviews with five early participants and two carers and so had good construct validity, reflecting the context (COVID-19 pandemic) in which the N-ROL programme was being delivered.

We tested the hypotheses that N-ROL would lead to an improvement in these outcome measures using paired t-tests. Statistical significance was set at a p value of <0.05. We quantified change using a standardised (Cohen's *d* for repeated-measures data) and unstandardised measure. The latter is a calculation of how much of the gap between the patients' baseline score and the highest possible score has been closed: the %maximum possible change. We performed post hoc analyses (paired t-tests) to see which questions were driving any significant effects.

A total of 144 patients were referred over 15 weeks. Note, 58 referrals did not progress to N-ROL: 13 did not meet the inclusion criteria; 12 were opposed to group-based treatment, 13 were opposed to internet-based treatment, 11 felt they had recovered or were receiving enough treatment; and 3 were unwell or uncontactable. Six patients planned to start N-ROL but never attended due to work/college commitments, internet difficulties or opposition to groups. Of the remaining 86 patients, predata/postdata were collected on at least one of the outcome measures for 74 patients (online supplemental figure S1). Summary demographic details of the 74 are as follows (median): age (65 years, IQR 54-74); days postinjury (81, IQR 34-174); gender (50% female); cause of ABI, stroke 95% (infarct 60%, haemorrhage 35%), trauma/other 5%; for those with a stroke and an National Institutes of Health Stroke Scale admission score ($n=36$; 4, IQR 2-9); living alone, 15%. Only 22 participants had additional community rehabilitation during N-ROL, ranging from 45 min once a fortnight to 4×30 min sessions a week, with a median 1.5 30-45 min sessions a week.

Each patient attended on average 27.1 session, a mix of physical and talking therapies (online supplemental figure S2), with an average of 5.4 patients per group. Data for each type of group are shown in online supplemental table S2. The structure of N-ROL interventions (numbers

of sessions and participants per session) remained unchanged throughout the 15 weeks, but the content of each group was iteratively adapted based on the needs and feedback of the participants.

Complete predata/postdata were available for SSEQ and N-ROLOM for 67 and 68 patients, respectively. Carer/family data (N-ROLOM) were available for just over half of participants (either no carer or unable to contact them).

There was a significant improvement on the SSEQ score ($t(67)=2.28$, $p=0.026$, $pre=25.9$, $post=27.8$). The standardised effect size was small (Cohen's $d=0.28$), with a 14% average maximum possible change.

The post hoc analyses revealed that this effect was driven by four questions: (1) prepare a meal you would like for yourself ($p=0.022$); (2) continue to do most of the things you liked to do before your stroke ($p=0.030$); (3) walk safely outside on your own on any surface ($p=0.030$); (4) walk a few steps on your own on any surface inside your house ($p=0.047$).

There was a significant improvement on the patient-based N-ROLOM questions ($t(68)=3.97$, $p<0.0005$, $pre=23.8$, $post=26.0$). The standardised effect size was medium (Cohen's $d=0.48$) with a 20% average maximum possible change (figure 1).

The post hoc analyses revealed that this effect was driven by three questions: (1) other stroke/brain injury survivors have helped me understand my own stroke/brain injury ($p<0.0005$); (2) I understand why I suffered a stroke/brain injury ($p=0.014$); (3) my day has a clear structure to it ($p=0.032$).

There was no significant improvement on the carer-based N-ROLOM questions ($t(33)=-0.90$, $p=0.374$).

In summary, patients who took part in N-ROL significantly improved on the two planned quantitative outcome measures. The post hoc analyses suggest that participants gained the most from (1) psycho-education around ABI, including hearing other people's stories; (2) gaining advice on how to better structure their day; and (3) perceived improvements in their motor function (meal preparation, balance and walking).

N-ROL, like all therapist-delivered rehabilitation, is complex with many interacting components. Each group was delivered by highly skilled and specialist neurotrained therapists. We speculate that key elements to its success are (1) the multidisciplinary structure of the team; (2) using groups, which allows participants to gain and identify with each other; and (3)

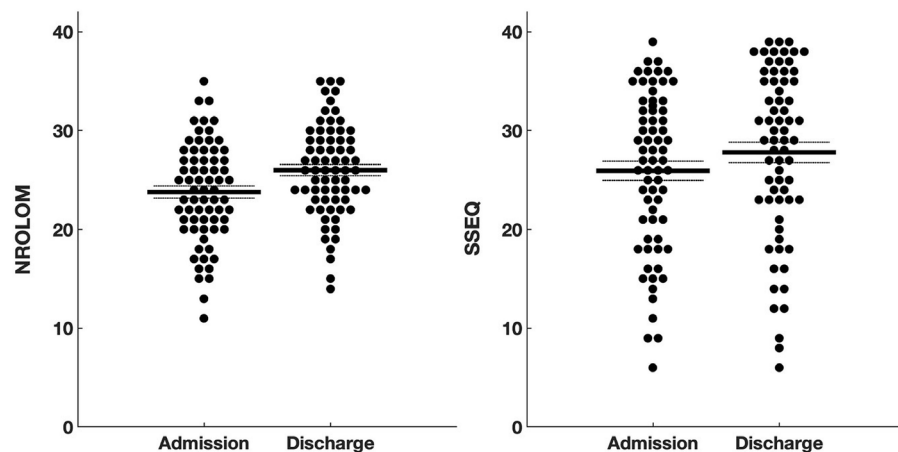


Figure 1 Premean and postmean scores (solid lines) with their associated SE of the mean (dotted lines) for the two main outcomes: N-ROLOM (max score=35) and SSEQ (max score=39). N-ROLOM, Neuro-Rehabilitation Online Outcome Measure; SSEQ, Stroke Self-Efficacy Questionnaire.

the holistic and systemic nature of our therapeutic approach (treating patients in their own home and targeting their carers for specific interventions). Analysis of the qualitative data will shed further light, but it is important to acknowledge that this intervention is at an early stage of development.

The absence of a control group precludes attributing these gains to N-ROL. However, it must be remembered that the rationale for starting N-ROL was to offer treatment/support in their own homes for recently discharged patients with ABI who would otherwise receive minimal or no treatment⁵ (75% of our patients). Future direct comparison with a no-treatment control group is unlikely to be feasible, but comparisons with existing community rehabilitation programmes, both in terms of clinical outcomes (general and domain specific) and cost-effectiveness would be of interest. We anticipate the emergence of hybrid online and face-to-face community treatment programmes in future, which may be tailored to local demographic and geographical needs.

Ben Beare,^{1,2} **Catherine E Doogan**,^{2,3} **Pedro Douglass-Kirk**,⁴ **Alexander P Leff** ,^{2,3} **Nick Ward** ,^{1,2}

¹Department of Clinical and Movement Neurosciences, UCL Queen Square Institute of Neurology, London, UK

²The National Hospital for Neurology and Neurosurgery, London, UK

³Department of Brain Repair and Rehabilitation, UCL Queen Square Institute of Neurology, London, UK

⁴Goldsmiths University of London, London, UK

Correspondence to Professor Nick Ward, Department of Clinical and Movement Neurosciences, UCL Queen Square Institute of Neurology, London WC1N 3BG, UK; n.ward@ucl.ac.uk

Twitter Nick Ward @dr_nickward

Acknowledgements The Neuro-Rehabilitation OnLine (N-ROL) team thanks the following who contributed to N-ROL at short notice and managed the steep learning curve of delivering online therapy admirably: Fran Brander, Kate Bull, Will Chegwidan, Bronwyn Cornish, Nikki Craven, Sasha Davis, Carys Evans, Shauna Feeney, Lizzy Flavell, Beth Gooding, Rachel Higgins, Ainslie Johnstone, Kate Kelly, Jenny Lee, Laura O'Flaherty, Matthew Pountain, Jean Rutter, Jenny Stadden, Amanda Strawson, Joe Ward and Rebecca Wells. We would also like to thank the following for valuable discussions: Dr Martha Turner and the Homerton Outreach Team; Rachel Okin, Claire Hunt and the Camden Community Neurorehabilitation Team; Professor Fiona Jones. N-ROL was funded by generous donations from members of the public from many countries, and we thank each and every one of them. Many thanks to Emilia Clarke, Jenny Clarke and the whole SameYou team for making the programme possible through their generous fundraising.

Contributors All authors contributed to the design, delivery and assessment of the work described here. All authors contributed to writing and editing of the manuscript. BB and CED contributed equally as first authors.

Funding Neuro-Rehabilitation OnLine was supported by a generous donation from the charity SameYou (charity number 1170102) and APL by National Institute of Health Research (RP-2015-06-012).

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have

been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

This article is made freely available for use in accordance with BMJ's website terms and conditions for the duration of the covid-19 pandemic or until otherwise determined by BMJ. You may use, download and print the article for any lawful, non-commercial purpose (including text and data mining) provided that all copyright notices and trade marks are retained.

© Author(s) (or their employer(s)) 2021. No commercial re-use. See rights and permissions. Published by BMJ.

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/jnnp-2021-326809>).

BB and CED contributed equally.



To cite Beare B, Doogan CE, Douglass-Kirk P, *et al.* *J Neurol Neurosurg Psychiatry* Epub ahead of print: [please include Day Month Year]. doi:10.1136/jnnp-2021-326809

Received 6 April 2021

Accepted 2 June 2021

J Neurol Neurosurg Psychiatry 2021;0:1–2.

doi:10.1136/jnnp-2021-326809

ORCID iDs

Alexander P Leff <http://orcid.org/0000-0002-0831-3541>

Nick Ward <http://orcid.org/0000-0002-7688-9649>

REFERENCES

- 1 Cramer SC. Intense rehabilitation therapy produces very large gains in chronic stroke. *J Neurol Neurosurg Psychiatry* 2019;90:497.
- 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 Fleming V, Brownsett S, Krason A, *et al.* Efficacy of spoken word comprehension therapy in patients with chronic aphasia: a cross-over randomised controlled trial with structural imaging. *J Neurol Neurosurg Psychiatry* 2020. doi:10.1136/jnnp-2020-324256. [Epub ahead of print: 05 Nov 2020].
- 4 Beyroufi R, Adams ME, Benjamin L, *et al.* Characteristics of ischaemic stroke associated with COVID-19. *J Neurol Neurosurg Psychiatry* 2020;91:889–91.
- 5 Wade DT. The future of rehabilitation in the United Kingdom National health service: using the COVID-19 crisis to promote change, increasing efficiency and effectiveness. *Clin Rehabil* 2021;35:471–80.
- 6 Riazzi A, Aspden T, Jones F. Stroke self-efficacy questionnaire: a Rasch-refined measure of confidence post stroke. *J Rehabil Med* 2014;46:406–12.