The Queen Square Upper Limb Neurorehabilitation Programme

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STROKE IS A CHRONIC AND PROGRESSIVE DISEASE

- 17 million people a year experience first stroke
- Survival is improving but still 1.5M survivors in UK
- Economic burden is high - £9B a year in UK
- Turn attention towards treatments to promote recovery
- Funding for stroke research lags behind dementia, CHD and cancer
Promoting Recovery After Stroke

Recovery after stroke is proportional

1. How to turn non-recoverers into (proportional) recoverers?
2. How to improve on regaining 70% of what is lost?
Promoting Recovery After Stroke

Stroke – post-stroke care

**Rehabilitation**

We need a step change in the provision of rehabilitation and long-term support for stroke survivors and their families. All stroke survivors should get an early assessment for rehabilitation in hospital, and receive appropriate levels of therapy both in hospital and following discharge. Post-hospital reviews should be available to all stroke survivors, wherever they live in Europe, and they should be able to get therapy (including for their psychological and non-physical needs) as long as they need it.
People with stroke should accumulate **at least 45 minutes** of each appropriate therapy every day, at a frequency that enables them to meet their rehabilitation goals, and for as long as they are willing and capable of participating and showing measurable benefit from treatment.

*Royal College of Physicians – National Clinical Guideline for Stroke*
UK SSNAP (stroke audit) data

<table>
<thead>
<tr>
<th></th>
<th>Three monthly</th>
<th>Four monthly</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Percentage of</td>
<td>85.6%</td>
<td>85.2%</td>
</tr>
<tr>
<td>patients reported as</td>
<td></td>
<td></td>
</tr>
<tr>
<td>requiring physiotherapy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2 Median number</td>
<td>35.0</td>
<td>33.8</td>
</tr>
<tr>
<td>of minutes per day</td>
<td></td>
<td></td>
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<tr>
<td>on which physiotherapy is received</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3 Median % of</td>
<td>71.9%</td>
<td>69.9%</td>
</tr>
<tr>
<td>days as an inpatient</td>
<td></td>
<td></td>
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<tr>
<td>on which physiotherapy is received</td>
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</tbody>
</table>

- Average stay in ASU = 17 Days
- 17 days * 35 mins * 74% = 7.3 hours in total
People are still INACTIVE and ALONE after stroke

Clinical messages

- Stroke survivors engage in a limited time of activity-related arm training during rehabilitation: less than four minutes during physiotherapy and 11 minutes during occupational therapy in acute rehabilitation; and less than six minutes during physiotherapy and 12 minutes during occupational therapy in subacute rehabilitation.
- Stroke survivors perform few activity-related arm movements, with less than 32 recorded during subacute rehabilitation across physiotherapy and occupational therapy.
Promoting Recovery After Stroke

Upper limb treatment – which intervention?

<table>
<thead>
<tr>
<th>Intervention</th>
<th>U1 function</th>
<th>U2 improvement</th>
<th>ADL</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral arm training</td>
<td>+</td>
<td>-</td>
<td>0</td>
<td>Moderate quality evidence of benefit on function, as compared to placebo or control. High quality evidence of no benefit or harm on ADL outcome.</td>
</tr>
<tr>
<td>Bilateral arm training</td>
<td>+</td>
<td>-</td>
<td>0</td>
<td>Moderate quality evidence of benefit on function, as compared to unilateral arm training at improving upper limb function</td>
</tr>
<tr>
<td>Biostimulation</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL outcome.</td>
</tr>
<tr>
<td>Biofeedback</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>Bobath therapy</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of a beneficial effect on mental practice</td>
</tr>
<tr>
<td>Brain stimulation: TDCS</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL outcome.</td>
</tr>
<tr>
<td>Brain stimulation: TMS</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL outcome.</td>
</tr>
<tr>
<td>CMT</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL outcome.</td>
</tr>
<tr>
<td>Electrical stimulation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>“Hands-on” therapy</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Moderate quality evidence of a beneficial effect on mental practice</td>
</tr>
<tr>
<td>Mental practice</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Moderate quality evidence of a beneficial effect on mental practice</td>
</tr>
<tr>
<td>Mirror therapy</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Moderate quality evidence of a beneficial effect on mental practice</td>
</tr>
<tr>
<td>Music therapy</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Moderate quality evidence of a beneficial effect on mental practice</td>
</tr>
<tr>
<td>Pharmacological interventions</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>Repetitive task training</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>Repetitive task training &gt; 20 hours dose</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>Robotics</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>Sensory interventions</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>Strength training</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>Stretching &amp; positioning</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>Task-specific training</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
<tr>
<td>Virtual reality</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of a beneficial effect on upper limb function and impairment, measured by Fugl-Meyer. Moderate quality evidence of no benefit or harm on ADL function.</td>
</tr>
</tbody>
</table>

Factors in service delivery:

<table>
<thead>
<tr>
<th>Factor</th>
<th>U1 function</th>
<th>U2 improvement</th>
<th>ADL</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose of intervention</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Moderate quality evidence of no benefit or harm from increased dose of intervention. High quality trial evidence and subgroup analysis relating to dose quantity required.</td>
</tr>
<tr>
<td>Location of intervention - home-based therapy</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>Evidence from comparison of computer-based training program with usual care. Evidence comparing delivery at home or at hospital is low quality.</td>
</tr>
<tr>
<td>Location of intervention - tele-rehabilitation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Evidence from comparison of computer-based training program with usual care. Evidence comparing delivery at home or at hospital is low quality.</td>
</tr>
</tbody>
</table>

Interventions for improving upper limb function after stroke
(Review)

Promoting Recovery After Stroke

Upper limb behavioural treatment – very early

A Self-Administered Graded Repetitive Arm Supplementary Program (GRASP) Improves Arm Function During Inpatient Stroke Rehabilitation
A Multi-Site Randomized Controlled Trial

Jocelyn E. Harris, MSc; Janice J. Eng, PhD; William C. Miller, PhD; Andrew S. Dawson, MD

(Stroke. 2009;40:2123-2128.)

- Patients recruited 2 weeks post-stroke
- Self-administered repetitive practice
- FM 39.5 (14.2) vs 40.0 (12.6)
- 1 hour 6 days a week for 4 weeks
- Difference maintained at retention

24 hours over 4 weeks
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Upper limb behavioural treatment – very early

- Tx started within 14 days post-stroke
- CIMT (60 mins therapy plus 3 hrs mitt)
- Continue with mitt for extra 5 weeks
- Control = 30 mins day for 3 weeks
- CIMT = 6-7 FM points advantage
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*Upper limb behavioural treatment – early*

Effects of intensity of arm training on hemiplegic upper extremity motor recovery in stroke patients: a randomized controlled trial

Chao Han, Qiang Wang, Ping-ping Meng and Ming-zhu Qi

<table>
<thead>
<tr>
<th>Table 2. Comparisons of outcomes of patients in three groups (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Group A</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td><strong>Before treatment</strong></td>
</tr>
<tr>
<td>FMA (UE)</td>
</tr>
<tr>
<td>ARAT</td>
</tr>
<tr>
<td>BI</td>
</tr>
<tr>
<td><strong>2 weeks after treatment</strong></td>
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<tr>
<td>FMA (UE)</td>
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<tr>
<td>ARAT</td>
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<tr>
<td>BI</td>
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<tr>
<td><strong>4 weeks after treatment</strong></td>
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<tr>
<td>FMA (UE)</td>
</tr>
<tr>
<td>ARAT</td>
</tr>
<tr>
<td>BI</td>
</tr>
<tr>
<td><strong>6 weeks after treatment</strong></td>
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<tr>
<td>FMA (UE)</td>
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<tr>
<td>ARAT</td>
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<tr>
<td>BI</td>
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</tbody>
</table>

FMA (UE), Fugl-Meyer Assessment (upper extremity); ARAT, Action Research Arm Test; BI, Barthel Index; Group A, Group B and Group C, each group received arm rehabilitation training for 1 hour, 2 hours and 3 hours a day respectively.

- Patients 40 (+/-20) days post-stroke
- Mean baseline FM 6-8
- Arm training 1, 2, 3 hrs/day, 5 days/wk, 6 wks
- Training depending on patient’s impairments
- Included correct positioning and caring of the arm; passive, assisted and active movements; strength training; practice of functional activities.

90 hours over 6 weeks
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Upper limb behavioural treatment – early

Original Investigation

Effect of a Task-Oriented Rehabilitation Program on Upper Extremity Recovery Following Motor Stroke
The ICARE Randomized Clinical Trial

Carolee J. Weinstein, PhD; Steven L. Wolf, PhD; Alexander W. Dromerick, MD; Christianne J. Lane, PhD; Monica A. Nelsen, DPT; Rebecca Lewthwaite, PhD; Steven Yong Cen, PhD; Stanley P. Azen, PhD; for the Interdisciplinary Comprehensive Arm Rehabilitation Evaluation (ICARE) Investigative Team

JAMA. 2016;315(6):571-581

30 hours over 10 weeks
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*Upper limb behavioural treatment* – chronic

**Mit-Manus**

- 36 hours over 12 weeks
- 127 patients (36 x 60 mins)
- Robot vs matched = -0.1 on UL-FM*
- Robot vs usual = +2.17 on UL-FM*

**ARMin**

- 18 hours over 8 weeks
- 73 patients (24 x 45 mins)
- Robot vs matched = +0.8 on UL-FM

*not significant*
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Upper limb behavioural treatment – chronic

300 hours of UL therapy over 12 weeks
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*Upper limb behavioural treatment – chronic*

**ML =**
- movement practice as close to normative as possible, high number of repetitions, attention to the motor task.
- Progression of training based on recovery of volitional capability and motor task difficulty
- ML exercises were provided for training-isolated joint movement coordination of the scapula, shoulder, elbow, forearm, wrist, fingers, and thumb; task component movements; and whole arm/hand functional training

**ROB =**
- InMotion2 Shoulder-Elbow Robot 1.5 hrs/day

**FES =**
- Passive cyclical FES for wrist and finger extensors 1.5 hrs/day
300 hours of UL therapy over 12 weeks = 8-11 points on UL-FM
Dose and timing in neurorehabilitation: prescribing motor therapy after stroke

Catherine E. Lang\textsuperscript{a,b}, Keith R. Lohse\textsuperscript{c}, and Rebecca L. Birkenmeier\textsuperscript{a}

KEY POINTS

- Larger amounts of therapy result in better outcomes for people beyond 2–3 months after stroke.
- Timing and amount of therapy may interact, such that larger amounts of therapy may not result in better outcomes for people in the first hours and days after stroke.
- Optimal dosing will not likely be a single value for everyone, but will vary based on clinical presentation of each individual.
- Preclinical and clinical studies are sorely needed to create a biologically driven and effective prescription process for stroke rehabilitation.
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Upper limb treatment – Queen Square Programme

FU OGL MEYER Scores at Admission, Discharge, 6 Weeks and 6 Months

Δ = 8.2

Upper Limb Rehabilitation Clinic
Do you still have difficulty using your arm after a stroke?
If you or a relative have suffered a stroke and still have problems using your arm, then you might be interested in this NHS service at The National Hospital for Neurology and Neurosurgery (NWHN), Queen Square.
The multidisciplinary service is run by Dr Nick Ward (Consultant Neurologist), Fran Brander (Physiotherapist), and Kate Kelly (Occupational Therapist) with expertise in assessing and treating upper limb problems.
In the clinic, we offer advice on the management of patients with neurological upper limb deficits secondary to central nervous system disease. We are particularly interested to see stroke survivors who might benefit from more intense treatment of upper limb deficits, especially early after stroke.
www.ucl.ac.uk/cnr/clinical/qs/nsnmd

90 hours over 3 weeks = 8.2 points on modified UL-FM
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*Upper limb treatment – Queen Square Programme*

- Patients require (i) at least flickers of extension at the wrist, fingers and thumb, (ii) at least minimal ability in reaching (see results for admission scores).

- Time since stroke 2-339 months, median 19 months

- Barriers to participation are (i) painful shoulder and (ii) severe spasticity. These patients are referred for appropriate treatment prior to consideration.

- Patients are ‘admitted’ for 3 weeks of intensive upper limb oriented therapy.

- 6 week & 6 month follow up outcome data
In total each patient received 90 hours upper limb therapy over the course of 3 weeks.

Daily treatment consists of:

✧ 2 hours each of OT and PT including analysis of movement and tasks, treatment of impairment and re-education of motor control within functional tasks.

✧ 2 hours of tailored, individualised interventions, including repetitive practice with a rehabilitation assistant, sensory retraining, adjuncts to therapy such as robotics, dynamic and functional orthoses and neuromuscular electrical stimulation, the GRASP and group work.

✧ Patients are encouraged to work on cardiovascular fitness during the programme.

✧ Education, self-efficacy and goal setting are integral components of the programme.
Chronic stroke patients can change by clinically important differences in measures of both impairment and activity following intensive upper limb rehabilitation.

Continued benefits were often seen for at least 6 months beyond the programme.

Ongoing work will:

- Describe the key elements in the programme - time on task, repetitions, category of task (e.g. active, sensory, functional, education, self-directed learning).
- Identify characteristics of those patients most likely to respond.
- Determine the effect of this intervention on quality of life (Stroke Impact Scale).
Upper limb therapy – role of technology

- Mass practice, high repetitions, high dose
- Repeatability
- Motivating, rewarding
- Used in patients own home

- Cost
- Evidence? Effect on on impairment, activity or participation?
- Where to get appropriate advice?
Promoting Recovery After Stroke

Upper limb treatment – use of technology

Saebo

SaeboMAS Dynamic Mobile Arm Support (patent pending)

The National Brain Appeal small acorns fund

friends of University College London Hospitals
Promoting Recovery After Stroke

Upper limb treatment – use of technology

Saebo

The National Brain Appeal
small acorns fund

friends
of University College London Hospitals
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Upper limb treatment – use of technology

Stroke survivors helped to recover by robotics

05 February 2016

The UK’s first clinical service that uses robotic devices to help rehabilitate stroke survivors’ arms and hands is taking place at the National Hospital for Neurology and Neurosurgery (NHNN).

The arms include the first Armeo Spring to be used in the NHS. Made by the Swiss company Hocoma, this piece of equipment was funded by the UCLH charity.

Now, the Armeo has been joined by two new pieces of equipment that are currently on loan from the Austrian robotics specialist Theragym. These are the Diego and Arradea, market-leading robots that work with the fingers and hand and arm respectively.

The arms – essentially mechanical exoskeletons – are attached to computer games which exercise specific upper body muscles. The robot can move the patient’s arm if they are unable to move it themselves. If the patient can move their arm, the equipment can self-adjust to provide appropriate levels of help.

Nick Ward, reader in clinical neurology, said: "Patients really benefit from the combination of intense hands-on therapy and repetition and practice with the robots. We’ve seen measurable and meaningful change in many of our stroke patients using this technology."

The service has also received funding from The National Brain Appeal.

Rehabilitation robotics were first introduced 20 years ago for patients with neurological disorders. They are now used more widely as a recovery method for patients.

The equipment helps patients to focus on their exercises by adding interest and variety; this complements the in-depth hands-on work conducted by NHNN’s team of therapists."
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Upper limb treatment – use of technology
Promoting Recovery After Stroke

Upper limb treatment – use of technology
Upper limb therapy - summary

- We don’t give enough to know what is possible through motor/behavioural training
- Simple task specific training seems less effective
- Treat at level of impairment, activity and participation = better ‘buy in’ and ultimately higher ‘dose’
- Dose response ‘emerging’ from clinical trials
- Pick appropriate outcome measure – e.g. impairment vs activity vs participation
- Need aspirational studies not pragmatic in rehab/restoration


Promoting Recovery After Stroke

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