A web-based intervention for upper limb rehabilitation following stroke

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How can the internet increase intensity of practice?

What this talk is about

- The way stroke rehabilitation is moving (in the UK…)

- Evidence for intensity of practice

- Rationale and potential benefits of rehabilitation technologies

- An example from our current research:
  - Web-based support programme for home-based upper limb rehabilitation

Future model of stroke rehabilitation

- Drive for cost-effective rehabilitation
- Targeting recovery
- Change in attitudes from dependence to independence
- Early Supported Discharge (ESD)
- Rehabilitation at home
- Improving assessment

Intensity

- A game of tennis:
  - 5 strokes / point
  - 10 points/game
  - 10 games/set
  - 3 sets/match
- = 750 strokes/ match
- How many repetitions in a therapy session?

Is there evidence to support 'increased dose'?

- In (human) stroke rehabilitation the typical number of repetitions in a session is 30 *(Lang et al, 2009)*

- In animals, changes in primary motor cortex synaptic density occur after 400 (but not 60) reaches *(Remple et al, 2001)*

- Might there be a 'threshold' above which UL use improves and below which it decreases *(Schweighofer et al, 2009)*

- Can the number be increased by providing other support to enable movement or giving motivating feedback?

The dose of UL treatment after stroke is unacceptably low

- Patients do very little in hospital

- Julie Bernhardt reported that patients are only active 13% of the day. And ALONE 60 % of the day

- Not the best environment to promote neuroplasticity

- Animal studies - need 400-600 reps of reach tasks

- On average patients achieve 32 reps in a therapy session

- Strong evidence that high dose of therapy is effective

- Incorporating high intensity of repetitive task practice

- Varied and goal orientated

Is More Better? Using Metadata to Explore Dose–Response Relationships in Stroke Rehabilitation

Keith R. Lohse, PhD; Catherine E. Lang, PT, PhD; Lara A. Boyd, PT, PhD

- Used regression models to predict improvement of function

- 30 studies 1750 participants

- Increased time scheduled was a predictor of clinically meaningful improvement

- Irrespective of time post-stroke

……But how can we achieve the required intensity in routine clinical practice?

Within the next 10 years rehabilitation technologies will used routinely in clinical practice

Rationale for technologies

What our patients tell us..

'Recovering from stroke is like watching paint dry – its difficult to keep motivated when you don't seem to be improving'

What are the key determinants of an effective motor training program?

- Intensity?
- Repetition?
- Task specific functional training?
- Providing feedback to patient?
- Alternating/changing tasks?

Sitting in a 3.8-metre sea kayak and watching a four-metre great white approach you is a fairly tense experience

MOTIVATION

If there is a better reason to paddle, I don't know what it is.

Constraint-Induced Movement Therapy (CIMT)

LifeGuide Platform

- Developed in Southampton - funded by the UK Research Council
- To motivate and support behavioral change e.g. drug addiction, obesity
- Software to create web-based interactive therapies that:
  - Give personalized advice and guidance based on the user's answers to questions
  - Support users to plan, chart and check their progress
  - Send supporting messages to users in the form of personalized emails or texts
  - Store and transmit data securely

LifeCIT- Rationale and Aims

- CIT has a sound neurophysiology base
- Has been shown to be effective

BUT

- Is costly in terms of contact time
- Evidence for efficacy as a home-based intervention
- But feedback has shown potential problems with adherence and motivation
- LifeCIT supports home-based CIT

LifeCIT Methodology

- STAGE 1: Co-design with patients, carers and therapists in a clinical / home environment
  - Web pages including designing a programme of assessment, activities, games, feedback and support
  - Interaction, communication and feedback support from therapists, friends and family
- STAGE 2: Pragmatic RCT (n=30) with stroke patients following discharge from hospital to:
  - Test feasibility and identify problems
  - Assess effect on upper limb function and quality of life
  - Estimate effect size compared with usual care
  - Monitor adherence

LifeCIT: Philosophy

- ***NOT:*** *'This is what you need to do….'* Giving instructions – the therapist is in charge

- ***BUT:*** *'What do you want to be able to do?'* The patient takes the lead – the system (LifeCIT) supports and guides

- Using this approach we aim to encourage self-efficacy and independence rather than compliance and dependence

Phase 1: Development of Prototype 1

- Meetings with therapists (6 sites each n=1-6) using power-point slides illustrating mock-ups of the proposed website
  - Therapists made suggestions about content of the website e.g. exercises, games, activities at different levels
  - Reviewed currently used exercise sheets for patients of different levels of ability
  - Discussed communication between therapists, patients and carers
- Designed and built first prototype LifeCIT website

Phase 1: Prototype 2. Developed via think-aloud studies with 12 sub-acute (<12 weeks) patients in hospital and at home

Developments based on observed patients' behavior navigating the website and simultaneous oral feedback

- Website navigation:
  - avoid multiple menu options - linear progression through the pages
  - no scrolling – all information on one page
- Clarity of instructions:
  - minimal text and avoiding ambiguity
  - motivational language and illustrations e.g. 'congratulations' 'use it or lose it'
  - Instructions via video with a voice-over rather than text
- Simplified computer games

Final Version of the Website

https://pips.ecs.soton.ac.uk/player/play/LifeCIT_demo

Enter a user ID: 2 numbers and 2 letters
PW: anything you like!

Welcome to LifeCIT

If this is your first time on the LifeCIT website then click this button:

Register

If you already registered with LifeCIT then click this button:

Login

If an existing LifeCIT user has given you a user name and password to view their progress, click this button: **Login**

What is LifeCIT?

LifeCIT is based on **Constraint Induced Therapy** (CIT).

In CIT you wear a special mitt on your better hand so that you use your stroke arm and hand more.

Using your stroke arm and hand could help to get the right areas of your brain working again!

A team of **rehabilitation experts** have designed LifeCIT using the most up-to-date evidence. Just click on 'meet the team' below to find out more about the LifeCIT team.

Meet the Team

Or click here to skip: **Next**

How can I get the most out of LifeCIT ?

Wear the mitt for up to 9 hours a day. The longer you wear it, the better the chances of improving.

Log onto LifeCIT each morning and plan daily activities that you can do using your stroke arm

Log on later in the day to tell LifeCIT what you have been doing

Play LifeCIT **computer games** and do some LifeCIT **arm exercises**

Click here to continue: Next

Using the Motor Activity Log (MAL)

- Personalized: a critical factor in motivation and adherence

- Activities that interest the individual

- Relate to personal objectives

- At the right level of ability

- The MAL is used to assess what the patient 'can do' and the data is then used to personalize the webpages

= your score

You are working towards level 3 !

Level 3

Level 2

Level 1

Start

Next

Set your goals for this week

Select goals by clicking on the small grey circles:

I will wear the mitt for:

1	2	3	4	5	6	7	8	9	10	hours a day
○	○	○	○	○	○	○	○	◉	○	

I will do activities for:

1	2	3	4	5	6	7	8	9	10	hours a day
○	○	○	◉	○	○	○	○	○	○	

I will play LifeCIT computer games for:

0	15	30	45	60	minutes, twice a day
○	○	◉	○	○	

The numbers in orange are our suggestions for a goal, but you can choose what is realistic for you this week

Next

Choosing activities

For yourself

Select **as many** activities as you like, from **any level**, by clicking on the small grey square. You can de-select an activity by clicking on the grey square again.

Level 1

- ☐ Wash face
- ☐ Brush hair
- ☐ Apply cream/moisturiser
- ☑ Eat a meal/snack with fingers

Level 2

- ☐ Brush teeth
- ☐ Style hair
- ☐ Pour a cold drink
- ☑ Drink from glass/cup
- ☐ Eat a meal/snack with cutlery
- ☐ Make a phone call
- ☐ Electric shave

Level 3

- ☐ Wet shave
- ☐ Put makeup on
- ☐ Prepare a simple meal/snack
- ☑ Open a letter
- ☐ Write a few sentences

Next

Wrist bending and straightening

- Place your forearm over the edge of a chair arm or table with the palm of your hand facing down

- Hold your arm with your other hand to keep it in place

- Lift your wrist as high as you can for a count of 3

- Lower your wrist down for a count of 3

- Repeat 5 times

Next

Later in the day…..

LifeCIT

Enter your progress

I wore the mitt for

0	1	2	3	4	5	6	7	8	9	10	hours
○	○	○	○	○	○	◉	○	○	○	○	

and

0	10	20	30	40	50	minutes.
◉	○	○	○	○	○	

Time for activities (with mitt on):

0	1	2	3	4	5	6	7	8	9	10	hours
○	○	○	○	◉	○	○	○	○	○	○	

and

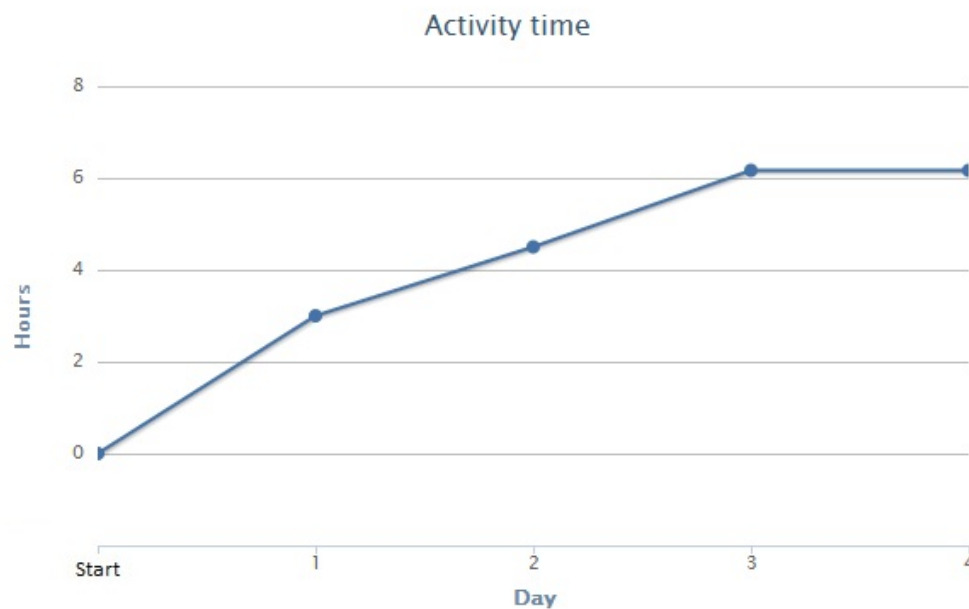| 0	10	20	30	40	50	minutes.
○	○	○	◉	○	○	

Click on the small grey circles to enter your progress

Please type any additional comments about your day here (optional):

Had a good day but I ran out of time to do all the activities. I'm now able to drink from a big glass!

Next

A graph of your progress for activity time

Activity time

The goal that you have set for this week is to do 4 hours of activities every day.

Next

Does a 3-week LifeCIT intervention improve upper limb function and maintained at six-month follow-up?

- Feasibility study - Pragmatic pilot RCT

- Patients recruited on discharge from hospital 7 days to 3 months post stroke and a second cohort post 16 weeks

- Selection criteria included safety using CIT at home, >10° wrist movement and >2.4 on the MAL

- Main outcome measures: WMFT and MAL (Baseline, post intervention and six-month follow up)

- Post treatment interviews with the patients who used LifeCIT

Results

Participants

- Screened: N=83 (60 did not meeting inclusion criteria 4 declined (3 could not use a computer)

- Recruited: Control N=8 Treatment N=11

- Drop-outs: 1 during the intervention (second stroke), 2 missed 6-month assessment (1 frozen shoulder and 1 unable to contact)

Summary of adherence data recorded on the LifeCIT Website

Activity	Mean (SD) Min-Max
Time the Mitt was worn each day (hours)	4.8 (2.6) 1.4–8.4
Total reported activity time / day (hours)	3.2 (1.7) 0.6–5.9
Number of activities completed / day	8.9 (4.9) 2.5–15.6
Days activity reported (max 21, target 15)	13.6 (2.1) 11-18

Between Group differences for main outcome measures

Outcome Measure	Mean difference between groups	ANCOVA P-Value (95% CI)
MAL / AOU Baseline to end of treatment Score - 0-5	1.00*	<0.003** (0.43-1.57)
MAL / AOU Baseline to follow-up	0.25	0.64 (0.95-1.44)
MAL / QOU Baseline to end of treatment Score 0-5	0.89*	<0.003** (0.36-1.40)
MAL / QOU Baseline to follow-up	0.46	0.42 (0.80-1.71)
WMFT (FAS) Baseline to end of treatment Score 0-5	0.45*	<0.001** (0.24-0.65)
WMFT (FAS) Baseline to follow-up	0.50*	0.15 (-0.24-1.24)

*Minimum Clinically Important Differences (MCID):

** between group sig P<0.05

MAL: 10% (i.e. 0.5) (Van der Lee Stroke 2003) - acute stroke

WMFT (FAS) 0.2-0.4 (Keh-chung NNR 2009)

What the participants had to say…

Key factors that changed behaviour were:

- Using the online system

- Using the C-MIT

- Components of the therapy: Activities of daily living/ functional goals were key for everyone

- Adapting over time to frustrations of wearing the C-Mitt

- Seeing functional gain

- Family Support and social encouragement

Summary

- Use of LifeCIT at home is feasible and well accepted by users (100% retention during the trial).

- Upper extremity function in sub-acute and chronic stroke patients improved following a three-week intervention and at a six-month follow-up.

- Only 1 participant declined to take part because they did not / could not use a computer

- Excellent adherence

- Positive feedback

Development

- LifeCIT has now been developed to be useful for lower functioning patients who would not be suitable for using CIT

- Web-based Interactive Support for recovery of the arm and hand after StrokE (WISE)

- Phase III multi-centre trial StrokeWISE with standard care (HTA)

Conclusions

- Technologies, especially those exploiting tele-health are likely to become normal practice

- To augment conventional practice

- To improve cost-effectiveness

- Currently there is a lack of evidence

- Motivation, self management and independence are key factors in rehabilitation

- Co-design with ALL users is key to acceptance – it must be very simple for patients

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Thank you

Questions?