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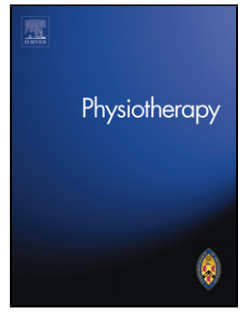

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Best practice for arm recovery post stroke: an international application

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Abstract

Objective To develop an evidence-based application ('app') for post-stroke upper extremity rehabilitation that can be used globally by physical therapists.

Participants Twenty-three experienced neurorehabilitation physical therapists, applied scientists and physicians, and 10 consultants dedicated to the provision of best practice to stroke survivors.

Design This team evaluated the evidence to support the timely and appropriate provision of interventions and the most defensible outcome measures during a 4-year voluntary information gathering and assimilation effort, as a basis for the sequencing of an algorithm informed by the data and directed by changes in impairment and chronicity.

Outcome measures The primary outcome was the formulation of a testable app that will be available for minimal user cost. The app is for a smartphone, and the comments of a focus group (audience at the World Confederation for Physical Therapy 2015 presentation, approximate n = 175) during a 30-minute 'Questions and Answers' session were assessed.

Results Analysis of documented, extensive input offered by the audience indicated a highly favourable disposition towards this novel tool, with provision of concrete suggestions prior to launching the final version. Suggestions centred on: inclusion of instructions; visuals and demonstrations; monitoring of adverse responses; availability of updates; autonomous use by patients; and potential to characterise practice.

Conclusions A simple, user-friendly app for decision making in the treatment of upper extremity impairments following stroke is feasible and welcomed.

Keywords: Cerebrovascular accident; Upper extremity; Motor activity; Portable electronic apps; e-Health

<A>Introduction

Rehabilitation clinicians are challenged to keep up with the volume of new evidence. Even after 17 years, the transformation and assimilation of evidence from discovery into practice is still incomplete [1,2]. The barriers that foster this untenable lag include: insufficient literature search and appraisal skills; lack of time; turnover in team members; compromised team communication; limitations in access to equipment; and treatment prioritisation [3,4]. Moreover, evidence syntheses and guidelines rarely provide recommendations specific to the dose and type of intervention, severity of impairment, time post injury and expected outcomes [5]. Given the reality that clinicians anticipate, if not expect, electronic forms of communication and transmission, there is a need to tailor the evidence using information technology to enhance uptake. To this end, an international group of clinicians and researchers in post-stroke rehabilitation reviewed existing recommendations, and recognised the opportunity to develop an algorithm for most compelling evidence treatments that could be incorporated into a smartphone app. This development and initial demonstration were provided at the 2015 World Confederation for Physical Therapy (WCPT) meeting, at which time, concrete suggestions for further improving the utility of the app were gathered. This report provides a brief history of development of the app and subsequent modifications prior to its release.

<A>Methods

<B>Participants

Twenty-three clinicians and researchers, and 10 consultants with expertise in the treatment of survivors of stroke and in exploring novel interventions to improve upper extremity function met in October 2010. They committed to frequent collaborative meetings and electronic communications as they gathered evidence to determine best practice to reduce impairments and enhance participation. The emphasis was on factors contributing to optimal limb use. Issues related to communication, visual perception and cognition were considered according to the extent that they affected the optimal application of interventions.

<B>Procedure

Initially, the group had to identify prognostic factors that could be incorporated into the algorithm. The algorithm for predicting upper limb capacity was based upon the Action Research Arm Test (ARAT), and builds on the presence of two clinical determinants measurable within 72 hours post stroke: (1) some voluntary shoulder abduction; and (2) some voluntary finger extension [6,7]. This shoulder-abduction-finger-extension (SAFE) model has shown that those patients demonstrating some voluntary finger extension and some visible shoulder abduction on day 2 after stroke onset had a 98% probability of achieving some upper limb function at 6 months post stroke [6]. In contrast, patients who did not show this voluntary motor control had a probability of only 25%. Remarkably, 60% of the patients with stroke showing some finger extension within 72 hours post stroke could regain full upper limb function as measured by the ARAT at 6 months post stroke [6]. Retesting the model on days 5 and 9 showed that the probability of regaining function remained 98% for those with some finger extension and shoulder abduction, whereas the probability decreased from 25% to 14% for those without this voluntary control [6].

The SAFE model also showed that a relatively large proportion of patients without finger extension may regain some upper limb capacity despite absence of finger extension within the first 72 hours post stroke [6]. Obviously, these false negatives in the SAFE model suggest that a number of patients with an initial poor prognosis for upper limb recovery may regain some finger extension, and, with that, upper limb capacity at 3 or 6 months post stroke. Repeated measurement analyses indicated that the time window for spontaneous return of finger extension strongly parallels the window of spontaneous neurological recovery restricted to the first 3 months post stroke [3,8,9]. Beyond this critical 3-month time window, motor function of the upper limb is defined [10], and clinical determinants used in prediction models become invariant for time-dependent changes [3,8,9]. These findings suggest that patients with an initial poor prognosis for upper limb capacity following the SAFE model need to be monitored weekly for return of some finger extension in the first 12 weeks post stroke.

<B>Algorithm construct

The prospects for regaining optimal use of the entire hemiparetic upper extremity are predicated upon time since stroke and volitional movement capability. Therefore, the time and relative severity of impairment became guiding factors in the construct of the algorithm shown in Fig. 1, which outlines the decision-making pathways generated by the group. The pathway asks therapists several key questions that direct them towards the most appropriate evidence-based interventions, as determined by the patient's presentation. The first question is whether the patient is within 12 weeks of stroke onset. This key question is relevant because of the importance of early monitoring, and research evidence has often been conducted separately on subacute and chronic populations. Secondly, the therapist is asked whether their patient has shoulder pain or is at risk of shoulder pain due to severe weakness of the shoulder muscles. An answer to this question allows interventions to address the possibility of shoulder pain applicable to patients of all levels of functional ability. The next stage asks three important questions, as shown in Fig. 1, related to (1) any voluntary muscle activity, (2) shoulder abduction and (3) finger extension. Answering ‘yes’ or ‘not yet’ to one or more of these questions will immediately direct the therapist to a different set of recommended therapies. Each ‘box’ is filled with interventions that are sequenced by feasibility of use and by importance as determined from questionnaire responses.

<insert Fig 1 near here>

Once at this page, there are a number of features to help the therapist decide on the best therapeutic option for their patient. Firstly, the technique is described, with a summary of the research evidence regarding what the benefits are and who for, the recommended dose, whether it can be applied in groups or self-administered, outcome measures and references appropriate to this intervention. There are also ratings for each intervention based on the research evidence (e.g. Level A is supported by at least one randomised controlled trial), feasibility of the intervention according to time and equipment required, and ease of use (4 stars for highly recommended by the majority of expert clinicians). An additional feature of the app is the ability to filter interventions based on patient characteristics, such as presence of neglect, cognitive impairment, aphasia and apraxia. Outcomes measures are provided through a comprehensive review of all the published literature that identified assessments used for each treatment within the ‘box’. Treatments were positioned in these locations based upon the evidence to support their use at that time and with the complement of impairments with which the patient presented. Treatments were also categorised according to the domains of the International Classification of Function framework.

<B>Audience feedback

The algorithm was explained to an international audience of participants at WCPT 2015 in Singapore. Ample time was provided for feedback, and all discussions were documented. The response to the algorithm was very favourable, characterised by phrases such as 'cutting edge' and 'relevant'. Many therapists noted the importance of easy accessibility to decisions, but were concerned about ease of use as most had little experience in on-line familiarity with applications' media. Other clinicians asked about the prospect for 'add-ons' so that patient data or recommended outcome measures could be inputted and transmitted. This range of inquiry reflects the scope of present knowledge, and future expectations expressed by those treating patients with stroke in many countries and in different settings. Discussion also revolved around the cost and sharing of apps, frequency of updates, available training media (pictures and videos) to demonstrate the best approach for specific interventions, independent patient use and, ultimately, evaluating the effect of app use on health outcomes.

<B>Implications

The implication from this effort is unequivocal. Collectively, this feedback provides information about additional components, including visuals and more detailed instructions for both use and user fees. However, the collegial dialogue also re-affirms the authors' belief that there is an appreciation, if not an expectation, for this medium amongst contemporary neurorehabilitation clinicians. Given that the mission underlying the development of this product was to assist the clinician in making informed and justified treatment decisions for upper extremity post-stroke rehabilitation at minimal cost, the intention is to cover costs related to further app updates, storage, information security, etc. without profit motive.

Conflict of interest: None declared.

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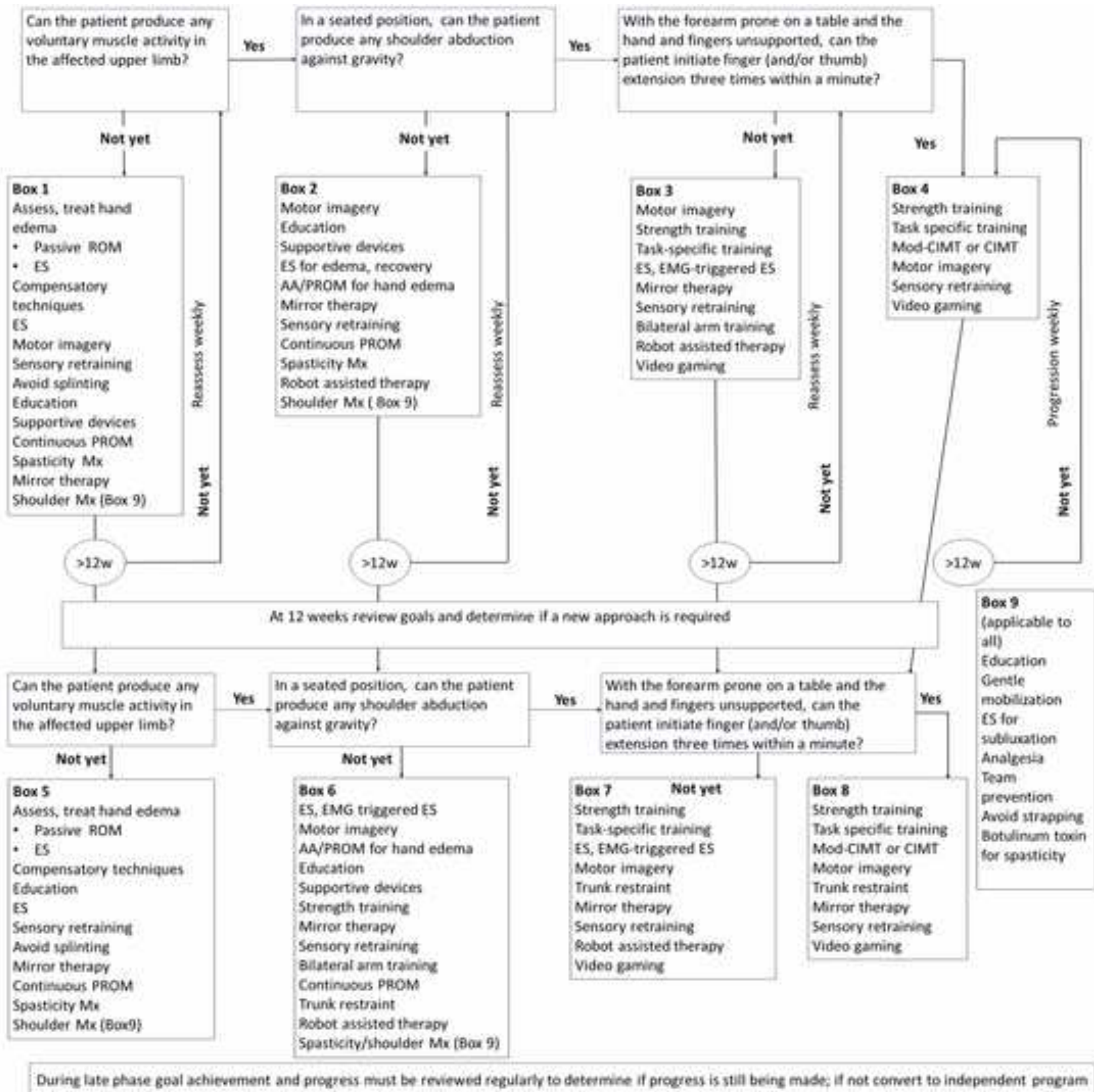
Legend

Fig. 1. The clinical decision-making algorithm underpinning the application. The app takes the user through the time post stroke (vertical axis) and relative severity (horizontal axis).


Can the patient produce any voluntary muscle activity in the affected upper limb?
Yes
In a seated position, can the patient produce any shoulder abduction against gravity?
Yes
With the forearm prone on a table and the hand and fingers unsupported, can the patient initiate finger (and/or thumb) extension three times within a minute?
Not yet
Not yet
Not yet
Yes
Box 1
Assess, treat hand edema
• Passive ROM
• ES
Compensatory techniques
ES
Motor imagery
Sensory retraining
Avoid splinting
Education
Supportive devices
Continuous PROM
Spasticity Mx
Mirror therapy
Shoulder Mx (Box 9)
Reassess weekly
Not yet
Box 2
Motor imagery
Education
Supportive devices
ES for edema, recovery
AA/PROM for hand edema
Mirror therapy
Sensory retraining
Continuous PROM
Spasticity Mx
Robot assisted therapy
Shoulder Mx (Box 9)
Reassess weekly
Not yet
Box 3
Motor imagery
Strength training
Task-specific training
ES, EMG-triggered ES
Mirror therapy
Sensory retraining
Bilateral arm training
Robot assisted therapy
Video gaming
Reassess weekly
Not yet
Box 4
Strength training
Task specific training
Mod-CIMT or CIMT
Motor imagery
Sensory retraining
Video gaming
Progression weekly
Not yet
>12w
>12w
>12w
>12w
At 12 weeks review goals and determine if a new approach is required
Box 9
(applicable to all)
Education
Gentle mobilization
ES for subluxation
Analgesia
Team prevention
Avoid strapping
Botulinum toxin for spasticity
Can the patient produce any voluntary muscle activity in the affected upper limb?
Yes
In a seated position, can the patient produce any shoulder abduction against gravity?
Yes
With the forearm prone on a table and the hand and fingers unsupported, can the patient initiate finger (and/or thumb) extension three times within a minute?
Yes
Not yet
Not yet
Box 5
Assess, treat hand edema
• Passive ROM
• ES
Compensatory techniques
Education
ES
Sensory retraining
Avoid splinting
Mirror therapy
Continuous PROM
Spasticity Mx
Shoulder Mx (Box9)
Box 6
ES, EMG triggered ES
Motor imagery
AA/PROM for hand edema
Education
Supportive devices
Strength training
Mirror therapy
Sensory retraining
Bilateral arm training
Continuous PROM
Trunk restraint
Robot assisted therapy
Spasticity/shoulder Mx (Box 9)
Box 7
Not yet
Strength training
Task-specific training
ES, EMG-triggered ES
Motor imagery
Trunk restraint
Mirror therapy
Sensory retraining
Robot assisted therapy
Video gaming
Box 8
Strength training
Task specific training
Mod-CIMT or CIMT
Motor imagery
Trunk restraint
Mirror therapy
Sensory retraining
Video gaming
During late phase goal achievement and progress must be reviewed regularly to determine if progress is still being made; if not convert to independent program