Stroke FOUNDATION

Clinical Guidelines for Stroke Management

Chapter 5 of 8: Rehabilitation

This is the fifth in a series of eight guideline chapters that provide evidence-based recommendations for recovery from stroke and TIA in adults.

Contact

Stroke Foundation
Melbourne, Victoria, Australia
guidelines@strokefoundation.org.au
+61396701000
https://informme.org.au/Guidelines

Sponsors/Funding

The Stroke Foundation gratefully acknowledges the previous financial assistance by the Australian Government, Medical Research Future Fund. The development of recommendations has not been influenced by the views or interests of the funding body.

Disclaimer

Sections

Summary of recommendations

Introduction

Methodology

Clinical questions

Rehabilitation - overview

Commencement of rehabilitation

Strong recommendation against

For stroke patients, starting intensive out-of-bed activities within 24 hours of stroke onset is not recommended. (Rethnam et al. 2020 *[14]*, Langhorne et al. 2018 *[15]*, Bernhardt et al. 2015 *[9]*)

Strong recommendation

All stroke patients should commence mobilisation (out-of-bed activity) within 48 hours of stroke onset unless otherwise contraindicated (e.g. receiving end-of-life care). (Bernhardt et al. 2015 *[9]*; Lynch et al. 2014 *[10]*)

Weak recommendation

For patients with mild and moderate stroke, frequent, short sessions of out-of-bed activity should be provided, but the optimal timing within the 48-hour post-stroke time period is unclear. (Bernhardt et al. 2015 *[9]*)

Amount of rehabilitation

Strong recommendation

- For stroke survivors, rehabilitation should be structured to provide as much scheduled therapy (occupational therapy and physiotherapy) as possible. (Lohse et al. 2014 *[26]*); Schneider et al. 2016 *[32]*; Veerbeek et al. 2014 *[96]*)
- For stroke survivors, group circuit class therapy should be used to increase scheduled therapy time. (English et al. 2015 *[23]*)

Good practice statement

Consensus-based recommendation
Stroke survivors should be encouraged to continue with active task practice outside of scheduled therapy sessions. This could include strategies such as:

- self-directed, independent practice;
- semi-supervised and assisted practice involving family/friends, as appropriate.

Weak recommendation

A minimum of three hours a day of scheduled therapy (occupational therapy and physiotherapy) is recommended, ensuring at least two hours of active task practice occurs during this time. (Lohse et al. 2014 *[26]*; Schneider et al. 2016 *[32]*)

Early supported discharge services

Strong recommendation

Where appropriate home-based coordinated stroke services are available (*see Practical information section*), early supported discharge services should be offered to stroke patients with mild to moderate disability. (Langhorne et al. 2017 *[39]*)

Home-based rehabilitation

Weak recommendation

Home-based rehabilitation may be considered as a preferred model for delivering rehabilitation in the community. Where home rehabilitation is unavailable, stroke patients requiring rehabilitation should receive centre-based care. (Rasmussen et al. 2016 *[51]*; Hillier et al. 2010 *[53]*)

Goal setting

Strong recommendation

- Health professionals should initiate the process of setting goals, and involve stroke survivors and their families and carers throughout the process. Goals for recovery should be client-centred, clearly communicated and documented so that both the stroke survivor (and their families/carers) and other members of the rehabilitation team are aware of goals set. (Sugavanam et al. 2013 *[71]*; Taylor et al. 2012 *[72]*)
- Goals should be set in collaboration with the stroke survivor and their family/carer (unless they choose not to participate) and should be well-defined, specific and challenging. They should be reviewed and updated regularly. (Sugavanam et al. 2013 *[71]*; Taylor et al. 2012 *[72]*)

Sensorimotor impairments

Weakness

Strong recommendation

For stroke survivors with reduced strength in their arms or legs, progressive resistance training should be provided to improve strength. (Dorsch et al. 2018 *[83]*)

Weak recommendation

- For stroke survivors with arm weakness, repetitive practice using assistive technology, constraint induced movement therapy (CIMT), and robotics may be used to improve arm strength. (de Sousa et al 2018 *[82]*)
- For stroke survivors with leg weakness, task specific training, repetitive practice using cycling, or electrical stimulation may be used to improve leg strength. (de Sousa et al 2018 *[82]*)

Weak recommendation

For stroke survivors with reduced strength in their arms or legs (particularly for those with less than antigravity strength), electrical stimulation may be used. (de Sousa et al. 2018 *[82]*; Nascimento et al. 2014 *[78]*)

Loss of sensation

Weak recommendation

For stroke survivors with sensory loss of the upper limb, sensory-specific training may be provided. (de Diego et al. 2013 *[84]*; Carey et al. 2011 *[86]*; Doyle et al. 2010 *[87]*)

Loss of cardiorespiratory fitness

Strong recommendation

For stroke survivors, rehabilitation should include individually-tailored exercise interventions to improve cardiorespiratory fitness. (Saunders et al. 2020 *[95]*)

Good practice statement

Consensus-based recommendations

- All stroke survivors should commence cardiorespiratory training during their inpatient stay.
- Stroke survivors should be encouraged to participate in ongoing regular physical activity regardless of their level of disability.

Visual field loss

Good practice statement

Consensus-based recommendations

- All stroke survivors should have an:
  - assessment of visual acuity while wearing the appropriate glasses, to check their ability to read newspaper text and see distant objects clearly;
  - examination for the presence of visual field deficit (e.g. hemianopia) and eye movement disorders (e.g. strabismus and motility deficit).

Activity limitations

Sitting

Strong recommendation

For stroke survivors who have difficulty sitting, practising reaching beyond arm's length while sitting with supervision/assistance should be undertaken. (Veerbeek et al. 2014 *[125]*)

Standing up from sitting

Strong recommendation

For stroke survivors who have difficulty in standing up from a chair, practice of standing up should be undertaken. (Pollock et al. 2014 *[134]*; French et al. 2016 *[232]*)

Standing

Strong recommendation

For stroke survivors who have difficulty with standing, activities that challenge balance should be provided (French et al. 2016 *[232]*, van Duijnhoven et al. 2016 *[153]*, Hugues et al. 2019 *[156]*).

Weak recommendation

For stroke survivors who have difficulty with standing, one or more of the following interventions may be used in addition to practising tasks that challenge balance:

- Virtual reality training, which may include treadmill training, motion capture or force sensing devices (e.g. Wii Balance Boards) (Zhang et al. 2021*[412]*; Laver et al. 2017 *[230]*)
- Visual or auditory feedback e.g. force platform biofeedback (Veerbeek et al. 2014 *[125]*; Stanton et al. 2017 *[155]*)
- Electromechanically assisted gait or standing training (Zheng et al. 2019 *[158]*)

Walking

Strong recommendation

Stroke survivors with difficulty walking should be given the opportunity to undertake tailored repetitive practice of walking (or components of walking) as much as possible. (French et al. 2016 *[232]*)

The following modalities may be used:

- Circuit class therapy (with a focus on overground walking practice) (English et al. 2017 *[420]*);
- Treadmill training with or without body weight support (Mehrholz et al. 2017 *[413]*; Nascimento et al. 2021 *[411]*).

Weak recommendation In review

For stroke survivors with difficulty walking, one or more of the following interventions may be used in addition to those listed above:

- Virtual reality training. (Zhang et al. 2021 *[412]*)
- Electromechanically assisted gait training. (Mehrholz et al. 2020 *[175]*)
- Biofeedback. (Stanton et al. 2017 *[155]*)
- Cueing of cadence. (Nascimento et al. 2015 *[176]*)
- Electrical stimulation. (Howlett et al. 2015 *[177]*)

Weak recommendation Updated evidence, no change in recommendation

For stroke survivors, individually fitted lower limb orthoses may be used to minimise limitations in walking ability. Improvement in walking will only occur while the orthosis is being worn. (Daryabor et al. (2021)*[449]*; Wada et al. 2021*[448]*)

Arm activity

Strong recommendation

For stroke survivors with some active wrist and finger extension, intensive constraint-induced movement therapy (minimum 2 hours of active therapy per day for 2 weeks, plus restraint for at least 6 hours a day) should be provided to improve arm and hand use. (Corbetta et al. 2015 *[236]*)

Remark: Information previously included on trunk restraint during therapy has been moved to the practical info tab.

Weak recommendation

For stroke survivors with at least some voluntary movement of the arm and hand, repetitive task-specific training may be used to improve arm and hand function. (French et al. 2016 *[232]*)

Weak recommendation

For stroke survivors with mild to severe arm weakness, mechanically assisted arm training (e.g. robotics) may be used to improve upper limb function. (Mehrholz et al. 2018 *[223]*)

Weak recommendation

Virtual reality and interactive games may be used to improve upper limb function. (Laver et al. 2017 *[283]*; Aminov et al. 2018 *[262]*)

Weak recommendation

For stroke survivors with mild to severe arm or hand weakness, electrical stimulation in conjunction with motor training may be used to improve upper limb function. (Howlett et al. 2015 *[177]*; Yang et al. 2019 *[266]*)

Weak recommendation

For stroke survivors with mild to moderate weakness of their arm, mental practice in conjunction with active motor training may be used to improve arm function. (Barcley-Goddard et al. 2020 *[225]*; Borges et al. 2018 *[243]*)

Weak recommendation

For stroke survivors with mild to moderate weakness, mirror therapy may be used as an adjunct to routine therapy to improve arm function after stroke. (Thieme et al. 2018 *[227]*)

Strong recommendation against

Hand and wrist orthoses (splints) should not be used as part of routine practice as they have no effect on function, pain or range of movement. (Tyson et al. 2011 *[228]*)

Weak recommendation against

Brain stimulation (transcranial direct stimulation or repetitive transcranial magnetic stimulation) should not be used in routine practice for improving arm function, and only used as part of a research framework. (Elsner et al. 2020 *[215]*; van Lieshout et al (2019)*[248]*; Hao et al. 2013 *[219]*)

Participation restrictions

Activities of daily living

Strong recommendation

- Community-dwelling stroke survivors who have difficulties performing daily activities should be assessed by a trained clinician. (Legg et al. 2017 *[269]*)
- Community-dwelling stroke survivors with confirmed difficulties in personal or extended activities of daily living should have specific therapy from a trained clinician (e.g. task-specific practice and training in the use of appropriate aids) to address these issues. (Legg et al. 2017 *[269]*)

Weak recommendation

For stroke survivors, virtual reality technology may be used to improve activities of daily living in addition to usual therapy. (Laver et al. 2017 *[283]*)

Weak recommendation against

For older stroke survivors living in a nursing home, routine occupational therapy is not recommended to improve activities of daily living function. (Sackley et al. 2015 *[268]*)

Weak recommendation against

Acupuncture is not routinely recommended to improve activities of daily living. (Yang et al. 2016 *[294]*)

Strong recommendation against

Administration of amphetamines to improve activities of daily living is not recommended. (Martinsson et al. 2007 *[281]*)

Weak recommendation against Updated evidence, no change in recommendation

Selective serotonin reuptake inhibitors should not be used to reduce disability. (Legg et al. 2021 *[453]*).

Weak recommendation against

Brain stimulation (transcranial direct stimulation or repetitive transcranial magnetic stimulation) should not be used in routine practice to improve activities of daily living and only used as part of a research framework. (Elsner et al. 2020 *[215]*; Hao et al. 2013 *[219]*)

Communication difficulties

Assessment of communication deficits

Info Box

Practice point

- All stroke survivors should be screened for communication deficits using a screening tool that is valid and reliable.
- Those stroke survivors with suspected communication difficulties should receive formal, comprehensive assessment by a specialist clinician to determine the nature and type of the communication impairment.

Aphasia

Good practice statement

Practice point
Assessment and treatment for aphasia should be offered as early as tolerated.

Strong recommendation Updated

For stroke survivors with aphasia, speech and language therapy should be provided to improve functional communication, reading comprehension, auditory comprehension, general expressive language and written language. (RELEASE 2021 *[424]*, Brady et al. 2016 *[299]*)

Remark:
Update approved by NHMRC August 2022.

Strong recommendation Updated

For stroke survivors with aphasia, early aphasia therapy, starting within the first 4 weeks post stroke should be provided to maximise language recovery (RELEASE et al. 2021*[424]*).

Remark:
Update approved by NHMRC August 2022.

Weak recommendation Updated

For stroke survivors in the acute phase (up to six weeks post stroke onset), language therapy sessions (direct time on task) ranging between 30-45 minutes, two-three days per week may be provided from stroke onset to week 6 post stroke, with additional therapy sessions during this acute phase being unlikely to yield any further benefit to language recovery (Godecke et al. 2020 *[428]*; RELEASE Collaboration 2021 *[443]*).

Remark:
Update approved by NHMRC August 2022.

Weak recommendation New

For stroke survivors with chronic aphasia (>6 months post stroke onset), intensive aphasia therapy (at least 10 hours/ week of therapist led, individual or group therapy for 3 weeks, together with 5 hours or more, per week of self-managed training) may be used to improve aphasia. (Breitenstein et al. 2017 *[426]*)

Remark:
Update approved by NHMRC August 2022.

Weak recommendation against Updated

Brain stimulation (transcranial direct current stimulation or repetitive transcranial magnetic stimulation), with or without traditional aphasia therapy, is not recommended in routine practice for improving speech and language function in chronic patients with aphasia and only used as part of a research framework. (Elsner et al. 2019 *[301]*; Hong et al. 2021*[430]*)

Remark:
Update approved by NHMRC August 2022.

Strong recommendation New

Communication partner training should be provided to health professionals or volunteers who interact with people with aphasia after stroke. (Simmons-Mackie et al 2016 *[432]*; Finch et al 2017 *[442]*; Power et al 2020 *[439]*)

Remark:
Update approved by NHMRC December 2022.

Weak recommendation New

Communication partner training may be provided to carers or family members of people with aphasia after stroke. (Simmons-Mackie et al 2010 *[433]*; Simmons-Mackie et al 2016 *[432]*)

Remark:
Update approved by NHMRC December 2022.

Info Box

Practice point
Where a stroke patient is found to have aphasia, the clinician should:

- Document the provisional diagnosis.
- Explain and discuss the nature of the impairment with the patient, family/carers and treating team, and discuss and teach strategies or techniques which may enhance communication.
- Identify goals for therapy, and develop and initiate a tailored intervention plan, in collaboration with the patient and family/carer.
- Reassess the goals and plans at appropriate intervals over time.
- Use alternative means of communication (such as gesture, drawing, writing, use of augmentative and alternative communication devices) as appropriate.

All written information on health, aphasia, social and community supports (such as that available from the Australian Aphasia Association or local agencies) should be available in an aphasia-friendly format.

Info Box

Practice point

- Stroke survivors with chronic and persisting aphasia should have their mood monitored.
- Environmental barriers facing people with aphasia should be addressed through training communication partners, raising awareness of and educating about aphasia to reduce negative attitudes, and promoting access and inclusion by providing aphasia-friendly formats or other environmental adaptations. People with aphasia from culturally and linguistically diverse backgrounds may need special attention from trained healthcare interpreters.
- The impact of aphasia on functional activities, participation and quality of life, including the impact upon relationships, vocation and leisure, should be assessed and addressed as appropriate from early post-onset and over time for those chronically affected.

Apraxia of speech

Weak recommendation

For stroke survivors with apraxia of speech, individually tailored interventions incorporating articulatory-kinematic and rate/rhythm approaches may be used. (Ballard et al. 2015 *[313]*)

In addition, therapy may incorporate (Ballard et al. 2015 *[313]*):

- Use of modelling and visual cueing.
- Principles of motor learning to structure practice sessions.
- Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT) therapy.
- Self-administered computer programs that use multimodal sensory stimulation.
- For functional activities, the use of augmentative and alternative communication modalities such as gesture or speech-generating devices is recommended.

Dysarthria

Weak recommendation Updated

For stroke survivors with dysarthria, interventions tailored to the individual which include speech production tasks that target connected speech may be provided, which may include for example strategies to reduce speaking rate, emphasize articulatory placement or increased loudness (e.g., LSVT®LOUD) (Mitchell et al. 2017 *[423]*; Finch et al. 2020 *[422]*)

Remark:
Update approved by NHMRC August 2022.

Cognitive communication deficits

Good practice statement

Consensus-based recommendations

Stroke survivors with difficulties in communication following right hemisphere damage should have input from a suitably trained health professional including:

- a comprehensive assessment,
- development of a management plan, and
- family education, support and counselling as required. (Lehman Blake et al. 2013 *[320]*; Ferre et al. 2011 *[321]*)

Management may include:

- Motoric-imitative, cognitive-linguistic treatments to improve use of emotional tone in speech production. (Rosenbek et al. 2006 *[322]*)
- Semantic-based treatment connecting literal and metaphorical senses to improve comprehension of conversational and metaphoric concept. (Lungren et al. 2011 *[323]*)

Cognition and perception difficulties

Assessment of cognition

Info Box

Practice points

- All stroke survivors should be screened for cognitive and perceptual deficits by a trained person (e.g. neuropsychologist, occupational therapist or speech pathologist) using validated and reliable screening tools, ideally prior to discharge from hospital.
- Stroke survivors identified during screening as having cognitive deficits should be referred for comprehensive clinical neuropsychological investigations.

Perception

Good practice statement

Consensus-based recommendations

- Stroke survivors with identified perceptual difficulties should have a formal perceptual (i.e. neurological and neuropsychological) assessment.
- Stroke survivors with an identified perceptual impairment and their carer should receive:
  - verbal and written information about the impairment;
  - an assessment and adaptation of their environment to reduce potential risk and promote independence;
  - practical advice/strategies to reduce risk (e.g. trips, falls, limb injury) and promote independence;
  - intervention to address the perceptual difficulties, ideally within the context of a clinical trial.

Attention and concentration

Good practice statement

Consensus-based recommendation

For stroke survivors with attentional impairments or those who appear easily distracted or unable to concentrate, a formal neuropsychological or cognitive assessment should be performed.

Weak recommendation

For stroke survivors with attention and concentration deficits, cognitive rehabilitation may be used. (Loetscher et al. 2019 *[329]*; Rogers et al. 2018 *[330]*; Virk et al. 2016 *[325]*)

Weak recommendation

For stroke survivors with attention and concentration deficits, exercise training and leisure activities may be provided. (Liu-Ambrose et al. 2015 *[326]*)

Memory

Weak recommendation New

For stroke survivors with memory deficits, cognitive rehabilitation may be used to improve memory function in the short term. Memory rehabilitation strategies may include internal (mental) strategies (e.g. association, mental rehearsal, rhymes) and external compensatory aids (e.g. notebooks, diaries, calendars, alarms, audio recordings, photos, mobile phones). (das Nair et al 2016 *[344]*; Withiel et al 2019 *[351]*)

Consensus recommendation Updated

Any stroke survivor found to have memory impairment causing difficulties in rehabilitation or adaptive functioning should:

- be referred to a suitably qualified healthcare professional for a more comprehensive neuropsychological and functional assessment of their memory abilities and needs;
- have their nursing and therapy sessions tailored to use techniques that capitalise on preserved memory abilities and existing memory strategies (both internal and external);
- be comprehensively trained on how to use internal strategies (e.g. assocation, mental rehersal, mnemonics) and external strategies (e.g. notebooks, diaries, audio recordings, smartphone memory apps and alarms);
- have therapy delivered in an environment as similar to the stroke survivor's usual environment as possible to encourage generalisation.

Executive function

Info Box

Practice points

- Stroke survivors considered to have problems associated with executive functioning deficits should be formally assessed by a suitably qualified and trained person, using reliable and valid tools that include measures of behavioural symptoms.
- For stroke survivors with impaired executive functioning, the way in which information is provided should be tailored to accommodate/compensate for the particular area of dysfunction.

Weak recommendation

For stroke survivors with cognitive impairment, meta-cognitive strategy and/or cognitive training may be provided. (Zucchella et al. 2014 *[360]*; Skidmore et al. 2015 *[364]*)

Limb apraxia

Info Box

Practice point
Stroke survivors who have suspected difficulties executing tasks but who have adequate limb movement and sensation should be screened for apraxia.

Weak recommendation

For stroke survivors with limb apraxia, interventions such as gesture training, strategy training and/or errorless learning may be provided. (Lindsten-McQueen et al. 2014 *[373]*)

Neglect

Info Box

Practice point
Any stroke survivor with suspected or actual neglect or impairment of spatial awareness should have a full assessment using validated tools.

Weak recommendation

For stroke survivors with symptoms of unilateral neglect, cognitive rehabilitation (e.g. computerised scanning training, pen and paper tasks, visual scanning training, eye patching, mental practice) may be provided. (Bowen et al. 2013 *[386]*)

Weak recommendation

For stroke survivors with symptoms of unilateral neglect, mirror therapy may be used to improve arm function and ADL performance. (Thieme et al. 2018 *[227]*)

Good practice statement

Consensus-based recommendations
Stroke survivors with impaired attention to one side should be:

- given a clear explanation of the impairment;
- taught compensatory strategies systematically, such as visual scanning to reduce the impact of neglect on activities such as reading, eating and walking;
- given cues to draw attention to the affected side during therapy and nursing procedures;
- monitored to ensure that they do not eat too little through missing food on one side of the plate.

Weak recommendation against Updated evidence, no change in recommendation

Non-invasive brain stimulation should not be used in routine clinical practice to decrease unilateral neglect, but may be used within a research framework. (Salazar et al 2018 *[396]*; Kwon et al 2018 *[394]*; Fan et al 2018 *[393]*)

Telehealth in rehabilitation

Weak recommendation New

Telehealth services may be used as an alternative approach to delivering rehabilitation, especially for patients who cannot access specialist rehabilitation in the community. It may also be used as an adjunct to in-person therapy. Delivering of specific interventions via telehealth should only be considered for those that have demonstrated benefits. (Laver et al 2020*[64]*)

Glossary and abbreviations

Introduction

The Stroke Foundation is a national charity that partners with the community to prevent, treat and beat stroke. We stand alongside stroke survivors and their families, healthcare professionals and researchers. We build community awareness and foster new thinking and innovative treatments. We support survivors on their journey to live the best possible life after stroke.

We are the voice of stroke in Australia and we work to:

- Raise awareness of the risk factors, signs of stroke and promote healthy lifestyles.
- Improve treatment for stroke to save lives and reduce disability.
- Improve life after stroke for survivors.
- Encourage and facilitate stroke research.
- Advocate for initiatives to prevent, treat and beat stroke.
- Raise funds from the community, corporate sector and government to continue our mission.

The Stroke Foundation has been developing stroke guidelines since 2002 and in 2017 released the fourth edition. In order for the Australian Government to ensure up-to-date, best-practice clinical advice is provided and maintained to healthcare professionals, the NHMRC requires clinical guidelines be kept current and relevant by reviewing and updating them at least every five years. As a result, the Stroke Foundation, in partnership with Cochrane Australia, have moved to a model of living guidelines, in which recommendations are continually reviewed and updated in response to new evidence. This approach was piloted in a three year project (July 2018 -June 2021) funded by the Australian Government via the Medical Research Future Fund.

This online version of the *Clinical Guidelines for Stroke Management* updates and supersedes the Clinical Guidelines for Stroke Management 2017. The Clinical Guidelines have been updated in accordance with the *2011 NHMRC Standard for clinical practice guidelines* and therefore recommendations are based on the best evidence available. The Clinical Guidelines cover the whole continuum of stroke care, across 8 chapters.

Review of the Clinical Guidelines used an internationally recognised guideline development approach, known as GRADE (**G**rading of **R**ecommendations **A**ssessment, **D**evelopment and **E**valuation), and an innovative guideline development and publishing platform, known as MAGICapp (**Ma**king **G**rade the **I**rresistible **C**hoice). GRADE ensures a systematic process is used to develop recommendations that are based on the balance of benefits and harms, patient values, and resource considerations. MAGICapp enables transparent display of this process and access to additional practical information useful for guideline recommendation implementation.

Purpose

The *Clinical Guidelines for Stroke Management* provides a series of best-practice recommendations to assist decision-making in the management of stroke and transient ischaemic attack (TIA) in adults, using the best available evidence. The Clinical Guidelines should not be seen as an inflexible recipe for stroke management; rather, they provide a guide to appropriate practice to be followed subject to clinical judgment and patient preferences.

Scope

The Clinical Guidelines cover the most critical topics for effective management of stroke, relevant to the Australian context, and include aspects of stroke management across the continuum of care including pre-hospital, assessment and diagnosis, acute medical and surgical management, secondary prevention, rehabilitation, discharge planning, community participation, and management of TIA. Some issues are dealt with in more detail, particularly where current management is at variance with best practice, or where the evidence needs translation into practice.

The Clinical Guidelines do not cover:

- Subarachnoid haemorrhage;
- Stroke in infants, children and youth, i.e. <18 years old (refer to Australian Childhood Stroke Advisory Committee, *Guideline for the diagnosis and acute management of childhood stroke – 2017*, and Victorian Subacute Childhood Stroke Advisory Committee, *Guideline for the subacute management of childhood stroke – 2019*, https://informme.org.au/Guidelines/Childhood-stroke-guidelines); or
- Primary prevention of stroke. (Refer to *Guidelines for the management of absolute cardiovascular disease risk 2012* (National Vascular Disease Prevention Alliance *[5]*) - https://informme.org.au/en/Guidelines/Guidelines-for-the-assessment-and-management-of-absolute-CVD-risk, and *Guideline for the diagnosis and management of hypertension in adults 2016* (Heart Foundation *[6]*) - https://www.heartfoundation.org.au/for-professionals/clinical-information/hypertension).

Target audience

The Clinical Guidelines are intended for use by healthcare professionals, administrators, funders and policy makers who plan, organise and deliver care for people with stroke or TIA during all phases of recovery.

Development
The Guidelines are published in eight separate chapters:
Pre-hospital care
Early assessment and diagnosis
Acute medical and surgical management
Secondary prevention
Rehabilitation
Managing complications
Discharge planning and transfer of care
Community participation and long-term care
The Clinical Guidelines have been developed according to processes prescribed by the National Health and Medical Research Council (NHMRC) under the direction of an interdisciplinary working group. Refer to the document on InformMe that details the Interdisciplinary Working Group Membership and Terms of Reference.

Use
The primary goal of the Clinical Guidelines is to help healthcare professionals improve the quality of the stroke care they provide.

Guidelines differ from clinical or care pathways (also referred to as critical pathways, care paths, integrated care pathways, case management plans, clinical care pathways or care maps). Guidelines are an overview of the current best evidence translated into clinically relevant statements. Care pathways are based on best practice guidelines but provide a local link between the guidelines and their use.

In considering implementation of the Guidelines at a local level, healthcare professionals are encouraged to identify the barriers, enablers and facilitators to evidence-based practice within their own environment and determine the best strategy for local needs. Where change is required, initial and ongoing education is essential and is relevant to all recommendations in the Guidelines.

Aboriginal and Torres Strait Islander People
Refer to the document on InformMe for information regarding Aboriginal and Torres Strait Islander people.

Decision-making
Stroke survivors should be treated in accordance with the principles of shared decision-making contained within the *Acute Stroke Care Clinical Standard*, *Acute Stroke Services Framework 2019* and *Rehabilitation Stroke Services Framework 2013*, which include, among other things, that treatment should be patient-centred. Therefore, stroke survivors should be involved in decisions about their care at all times; but where they do not have capacity, or have limited capacity, family members should be involved in the decision-making.

Consent
The principles of informed consent underpin these Clinical Guidelines and therefore the wording of the recommendations are directed at the healthcare professional; that is, the intervention should/may be used, rather than offered, for the stroke patient. For patients with aphasia and/or cognitive disorders requiring formal consent, easy English or aphasia-friendly written versions of an information sheet and consent form should be offered and clearly explained to patients and their families in order to assist understanding and agreement.

Endorsement
The Clinical Guidelines have been endorsed (based on the 2017 version) by a number of organisations and associations. Refer to the document on InformMe that details the organisations formally endorsing the Clinical Guidelines.

Evidence gaps
Refer to the document on InformMe that details the gaps in evidence identified, noting areas for further research.

Reports
Refer to documents on InformMe - Technical Report, Administrative Report and Dissemination and Implementation Report.

Resources
Refer to documents on InformMe that provide supporting resources to assist with implementation of the Clinical Guidelines.

Publication Approval

Australian Government

National Health and Medical Research Council

The 2017 guideline recommendations were approved by the Chief Executive Officer of the National Health and Medical Research Council (NHMRC) on 25 July 2017 under Section 14A of the National Health and Medical Research Council Act 1992 with a subsequent amendment approved on 22 November 2017. Since moving to a continual (living) guideline model, further updates have been approved:

- 9 July 2018 (updated recommendations for neurointervention)
- 7 November 2019 (updated recommendations for thrombolysis, acute antiplatelet therapy, and patent foramen ovale management)
- 11 February 2021 (updated recommendations for oxygen therapy, cholesterol lowering targets, new acute antiplatelet agent, shoulder pain and weakness)
- 7 July 2021 (updated recommendations for standing, antiplatelet therapy, and activities of living)
- 22 December 2021 (updated recommendations for pre-hospital care, acute telehealth, head position, telehealth for rehabilitation, swelling of extremities, memory, management of atrial fibrillation, lifestyle modifications, and virtual reality for arm function)
- 5 August 2022 (updated recommendations for pre-hospital care [mobile stroke unit], assessment for rehabilitation, aphasia, dysarthria, prevention and treatment for depression, treatment of anxiety, personality and behaviour, pressure injury)
- 6 December 2022 (updated recommendations for aphasia and incontinence).
- 27 July 2023 (updated recommendations for driving, neurointervention, oxygen therapy, and central post-stroke pain).

In approving the guidelines recommendations the NHMRC considers that they meet the NHMRC standard for clinical practice guidelines. This approval is valid for a period of five years.

NHMRC is satisfied that the guideline recommendations are systematically derived, based on identification and synthesis of the best available scientific evidence and are developed for health professionals practising in an Australian health care setting.

This publication reflects the views of the authors and not necessarily the views of the Australian Government.

Disclaimer

These Clinical Guidelines are a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The Clinical Guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development.

Funding

The Stroke Foundation gratefully acknowledges the financial assistance provided to establish the living guidelines between 2018-2021 by the Australian Government, Medical Research Future Fund. Funding is currently being provided by the Australian Living Evidence Consortium (https://livingevidence.org.au) to assist the continuation of the Stroke Living Guidelines. The development of the final recommendations are not influenced by the views or interests of any funding body.

Citation

Stroke Foundation. Clinical Guidelines for Stroke Management. Available at https://informme.org.au/en/Guidelines/Clinical-Guidelines-for-Stroke-Management. Accessed [insert date, month and year and if applicable specific sections or chapters].

Methodology

Development of questions

Questions have been extensively developed and reviewed over the four iterations of the guidelines. In this 'living' phase the Content Steering Group reviews the PICO questions on an annual basis. The clinical questions are listed at the start of each chapter. Individual PICOs (population, intervention/s, comparator, outcomes) are listed in the research evidence section as related to each topic or recommendation.

Literature identification

On a monthly basis, we monitor the literature for relevant, new evidence by screening all randomised controlled trials or systematic reviews related to stroke published in the Pubmed database. One member of the project team initially screens all abstracts and excludes clearly irrelevant studies. Potentially included studies are allocated to relevant topics covered by the guidelines and a second member of the project team reviews and confirms included studies prior to sending to the relevant working group members. In addition, each month new economic studies and studies related to patient values and preferences are also captured.

Clinical expert review

Where new evidence has been identified by the project team a summary is sent to content experts who review and make a final decision to include or exclude the study and also to assess the potential impact of the new evidence on current recommendations. As a result of this assessment one of two options will be communicated for each topic:

a. New evidence is unlikely to change current recommendations: review and potentially integrate information in the next review cycle; or
b. New relevant evidence may change current recommendations: rapidly review.

Data extraction, updating evidence summary and GRADE profile

For rapid updates, the project team incorporates the new evidence into the existing body of evidence by:

- Updating the Summary of Findings table including the risk of bias assessment
- Review any additional studies related to Preferences and values of patients on the topic

Concurrently members of the economic working group review newly published economic studies.

The project team then drafts changes to the overall summary (GRADE profile). This profile is then reviewed and modified by clinical content experts and people with relevant lived experience (consumers). Finally changes to the changes to the recommendation, rationale and practical considerations are considered, discussed and agreed.

Draft changes are then circulated to the wider expert working groups (including consumer panel) for internal review. Once signed off by the Steering Group a period of public consultation is undertaken. Feedback is then reviewed and any changes made in response to feedback before finally submitting to the National Health and Medical Research Council (NHMRC) for approval.

Brief summary of GRADE

The Guidelines were developed following the GRADE methodology (Grading of Recommendations, Assessment, Development and Evaluation).

GRADE 'evidence to decision' framework includes a minimum of four factors to guide the development of a recommendation and determine the strength of that recommendation:

1. The balance between desirable and undesirable consequences.
2. Confidence in the estimates of effect (quality of evidence).
3. Confidence in values and preferences and their variability (clinical and consumer preferences).
4. Resource use (cost and implementation considerations).

For full details of how GRADE is used for developing clinical recommendations, refer to the GRADE handbook, available at: http://gdt.guidelinedevelopment.org/app/handbook/handbook.html.

Strength of recommendations

The GRADE process uses only two categories for the strength of recommendations, based on how confident the guideline panel is that the "desirable effects of an intervention outweigh undesirable effects [...] across the range of patients for whom the recommendation is intended" (GRADE Handbook):

- Strong recommendations: where guideline authors are certain that the evidence supports a clear balance towards either desirable or undesirable effects; or
- Weak recommendations: where the guideline panel is uncertain about the balance between desirable and undesirable effects.

These strong or weak recommendations can either be for or against an intervention. If the recommendation is against an intervention this means it is recommended NOT to do that intervention. There are a number of recommendations where we have stated that the

intervention may only be used in the context of research. We have done this because these are guidelines for clinical practice, and while the intervention cannot be recommended as standard practice at the current time, we recognise there is good rationale to continue further research.

The implications of a strong or weak recommendation for a particular treatment are summarised in the GRADE handbook as follows:
Table 1: Implications of GRADE recommendation categories (for a positive recommendation) for patients, clinicians and policy makers. Source: GRADE Handbook (http://gdt.guidelinedevelopment.org/app/handbook/handbook.html)

	Strong Recommendation	Weak Recommendation
For patients	Most individuals in this situation would want the recommended course of action and only a small proportion would not.	The majority of individuals in this situation would want the suggested course of action, but many would not.
For clinicians	Most individuals should receive the recommended course of action. Adherence to this recommendation according to the guideline could be used as a quality criterion or performance indicator. Formal decision aids are not likely to be needed to help individuals make decisions consistent with their values and preferences.	Recognise that different choices will be appropriate for different patients, and that you must help each patient arrive at a management decision consistent with her or his values and preferences. Decision aids may well be useful helping individuals making decisions consistent with their values and preferences. Clinicians should expect to spend more time with patients when working towards a decision.
For policy makers	The recommendation can be adapted as policy in most situations including for the use as performance indicators.	Policy making will require substantial debates and involvement of many stakeholders. Policies are also more likely to vary between regions. Performance indicators would have to focus on the fact that adequate deliberation about the management options has taken place.

For topics where there is either a lack of evidence or insufficient quality of evidence on which to base a recommendation but the guideline panel believed advice should be made, statements were developed based on consensus and expert opinion (guided by any underlying or indirect evidence). These statements are labelled as ‘Practice statements’ and correspond to 'consensus-based recommendations' outlined in the NHMRC procedures and requirements.

For topics outside the search strategy (i.e. where no systematic literature search was conducted), additional considerations are provided. These are labelled ‘Info Box’ and correspond to ‘practice points’ outlined in the NHMRC procedures and requirements.

Explanation of absolute effect estimates used
The standardised evidence profile tables presented in the Clinical Guidelines include “Absolute effect estimates” for dichotomous outcomes. These represent the number of people per 1000 people expected to have the outcome in the control and intervention groups. This estimated risk in people receiving the intervention is based on a relative effect estimate which might be adjusted, e.g. to account for baseline differences between participants or when effect estimates have been pooled from different studies in a systematic review and adjusted to account for the variance of each individual estimate. Therefore, this estimated risk in the intervention group may differ from the raw estimate of the intervention group risk from the corresponding study. The estimated risk reflects the best estimate of the risk in the relevant population, relative to the risk observed among patients receiving the control or comparator intervention.

Wherever possible (i.e. when the relevant study reported enough information to allow the calculation to be done), these estimates were calculated using the following procedure:
1. Obtain the relative effect estimate (odds ratio or relative risk) and confidence interval from the best available study (systematic review or primary study) providing evidence about the effects of the intervention.
2. Use the observed number of events in the control group of the same study to calculate a baseline risk per 1000 people (or “assumed control risk”).
3. Calculate an estimate of the corresponding risk per 1000 in people receiving the intervention using the relative effect estimate. This can be done using methods based on the formulas for calculating absolute risk reductions provided in the *Cochrane Handbook for Systematic Reviews of Interventions* (http://handbook.cochrane.org/). Applying the same calculations to the upper and lower bounds of the confidence interval for the relative effect estimate gives a confidence interval for the risk in the intervention group, which is then used to calculate the confidence interval for the difference per 1000 people, reported in the evidence tables.

Cost effectiveness summaries
There are several important points to consider when interpreting the cost-effectiveness information provided in the *Resources and Other Considerations* sections of the Clinical Guidelines.

Firstly, an intervention can be cost-effective without being cost-saving. This means that although there is an additional cost for the health benefits gained from the intervention, the intervention is still considered worthwhile. The incremental cost-effectiveness ratios (ICER) presented (e.g. cost per quality adjusted life year gained) are an indication of the cost-effectiveness or "value-for-money", with lower ICERs indicating better cost-effectiveness of an intervention.

Secondly, whether or not the intervention is cost-effective is a judgment call; and should reflect a society's willingness-to-pay to have the intervention for the potential outcomes achieved. An ICER that is approximately or equivalent to US$50,000 has been commonly used by researchers in the past as a threshold for judging an intervention as being cost-effective (http://www.nejm.org/doi/full/10.1056/NEJMp1405158#t=article). However, no scientific basis for this threshold exists and actual willingness-to-pay may differ. For example, in a survey of 1000 Australian respondents conducted in 2007, the willingness-to-pay for an additional quality adjusted life year in Australia was estimated to be $64,000 (https://www.ncbi.nlm.nih.gov/pubmed/19382128).

Thirdly, there is no absolute threshold for determining whether an intervention should be funded based on the ICER (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5153921/). ICERs are only one of the major factors considered in priority setting (the process to decide which interventions should be funded within a given resource constraint). Other considerations include affordability, budget impact, fairness, feasibility and other factors that are important in the local context (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5153921/).

Lastly, in areas where there are no data from economic evaluations that support the recommendations or practice statements, it remains unclear whether the additional costs of providing the intervention above usual care for the additional potential benefits obtained is justified. However, this should not detract from implementing the Clinical Guideline recommendations.

Use of language related to timing of interventions
***Immediate*:** without delay, or within minutes, not hours (life critical action required).
***Urgent*:** minutes to several hours (immediate action but not life critical).
Very early: within hours and up to 24 hours.
Early: within 48 hours.

For all Clinical Guideline recommendations we make the assumption that healthcare professionals will be appropriately qualified and skilled to carry out the intervention.

Clinical questions

5.1 When is the best time to start out of bed activities?

5.2 When is the best time to start communication training?

5.3 What is the best amount of therapy to improve movement ability in the acute period (0 to 7 days)?

5.4 What is the best amount of therapy to improve movement ability in the early and late subacute periods (7 days to 3 months) and chronic period (> 6 months)?

5.5 What is the best amount of therapy to improve communication in the acute period (0 to 7 days)?

5.6 What is the best amount of therapy to improve communication in the early subacute periods (7 days to 3 months)?

5.7 Does access to early supported discharge services improve outcomes for people with stroke?

5.8 Is home based rehabilitation more effective than hospital based care in reducing mortality and increasing independence amongst stroke patients?

5.9 Does patient-centred goal setting improve patient outcomes?

5.10 What interventions for strength improve outcomes for stroke survivors?

5.11 What interventions increase sensation in stroke survivors?

5.12 What interventions to improve cardiovascular fitness improve outcomes for people with stroke?

5.13 What interventions (compensatory or restorative) improve visual field loss?

5.14 What task-specific training improves outcomes for stroke survivors who have difficulties sitting?

5.15 What task-specific training improves outcomes for stroke survivors who have difficulties standing up?

5.16 What task-specific training improves outcomes for stroke survivors who have difficulties standing?

5.17 What interventions improve walking ability in stroke survivors?

5.18 What interventions improve upper limb activity in stroke patients who have difficulty using their upper limbs?

5.19 What interventions improve ADL in patients with stroke?

5.20 Assessment of communication deficits

5.21 What interventions improve outcomes for patients with aphasia?

5.22 What interventions improve outcomes for people with apraxia of speech?

5.23 What interventions improve outcomes for people with dysarthria?

5.24 What interventions improve outcomes in stroke patients with cognitive communication difficulties?

5.25 Assessment of cognition

5.26 What interventions improve perceptual impairment in stroke survivors?

5.27 What interventions improve outcomes in stroke patients with attention and concentration deficits?

5.28 What interventions improve outcomes in stroke patients with memory difficulties?

5.29 What interventions to initiate everyday activities in stroke patients improve impaired executive functioning?

5.30 What interventions improve outcomes for stroke patients with limb apraxia?

5.31 What interventions improve the outcome of stroke patients with unilateral spatial neglect?

5.32 Does the use of telehealth improve outcomes for patients with subacute stroke?

Rehabilitation - overview

Rehabilitation is a holistic process that should begin the first day after stroke with the aim of maximising the participation of the person with stroke in the community. To achieve this, tailored interventions that focus on impairment, activity and participation levels (based on the World Health Organisation International Classification of Functioning model) should be considered. Therefore rehabilitation as a process can occur in a variety of settings, including in hospital on acute or specialised rehabilitation wards, in the home, or in community outpatient settings. For some aspects of care (e.g. screening and management of dysphagia) early intervention is critical and therefore this topic has been included in the Acute medical and surgical chapter, but they continue to be relevant beyond the initial few days after stroke. This chapter discusses interventions targeting impairments (sensorimotor, communication and cognitive) and activities. The Managing complications chapter discusses secondary impairments or complications (i.e. impairments that result from the primary impairments). The Community participation and long-term care chapter discusses aspects of care related to participation and reintegration into the community, including self-management.

Stroke survivors being treated within a rehabilitation framework should always be constantly monitored and reviewed for signs of deterioration, and in this situation referred to their treating neurologist or medical stroke specialist.

Commencement of rehabilitation

Mortality and morbidity are reduced when people with stroke receive care in stroke units (Stroke Unit Trialists 2020 *[13]*). One component of stroke unit care is early mobilisation. "Mobilisation" is defined as out-of-bed activities and can include sitting out of bed, standing and walking (Bernhardt et al. 2015 *[9]*). While the best timing to commence active rehabilitation including mobilation is evolving observational studies have found very little therapy is provided during acute inpatient care. Serra et al (2016)*[19]* found 36.7 minutes of combined physiotherapy and occupational therapy was provided per day of which about 8 minutes focused on upper limb rehabilitation.

Note: additional information regarding commencement of therapy specifically for aphasia is also available. Please refer to the section on Communication difficulties.

Strong recommendation against

For stroke patients, starting intensive out-of-bed activities within 24 hours of stroke onset is not recommended. (Rethnam et al. 2020 *[14]*, Langhorne et al. 2018 *[15]*, Bernhardt et al. 2015 *[9]*)

Practical Info

Intensive out-of-bed activities (not recommended) typically consist of about 6 out-of-bed activities per day (Bernhardt et al. 2015*[9]*). Baseline stroke severity and stroke type should be considered when deciding when and how much to mobilise after stroke. Patients who are independently mobile should not have their mobility restricted during the early phase after stroke.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Subgroup analysis of a very large, multi-centre randomised controlled trial found that in patients with intracerebral haemorrhage and more severe stroke, very early, intensive mobilisation (less than 24 hours post-stroke) may cause harm (78 fewer patients with favourable outcome per 1000 patients treated) (Bernhardt et al. 2015 *[9]*). Individual patient data meta-analysis from five trials found VEM led to less favourable outcome at 3 months (mRS 0-2) (OR 0.75, 95%CI 0.62-0.92). While not significant there was a trend to increase mortality which was more event for patients with severe stroke and haemorrhagic stroke. There was no difference in ADL (Rethnam et al 2020 *[14]*).

Certainty of the Evidence

Low

The quality of evidence regarding shorter, more frequent sessions is based on pre-specified dose-response sub-group analyses (n = 2104 patients) of a high-quality, multi-centre randomised controlled trial.

Values and preferences

Substantial variability is expected or uncertain

Baseline stroke severity and stroke type should be considered when deciding when and how much to mobilise after stroke.

Areas of major debate

There is debate on the optimal timing of early mobilisation based on interpretation of the AVERT trial. Some clinicians believe that mobilisation within 24 hours should not be used due to harms reported, while others believe that a negative recommendation may lead to prolonged immobilisation, and a recommendation of a wider time window shown to be safe should be made instead.

Resources and other considerations

Important issues, or potential issues not investigated

<u>Resources considerations</u>

There is currently little economic evidence on the potential cost-effectiveness of very early rehabilitation interventions within 24 hours of stroke onset (Gao et al 2019*[17]*). In a multi-country randomised control trial (n=2104; with 1054 patients from Australia) the cost-effectiveness of a very early mobilisation rehabilitation intervention in addition to usual care was compared to usual care alone. Health care utilisation and other costs (for example home modification, change in accommodation, informal

care, changes to employment) were collected on cost case report forms. Country specific unit prices were then applied to calculate costs. At the 12 months follow up period, there was no evidence that the intervention was cost-effective when compared with usual care from a health sector perspective or a societal perspective. Costs and QALYs were not significantly different between the two groups.

Rationale

Secondary analysis of a large, multi-centre randomised controlled trial found poorer outcomes with early mobilisation for those with intracerebral haemorrhage and more severe stroke (Bernhardt et al. 2015 *[9]*.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Very early mobilisation (<24 hrs)
Comparator: Usual care

Summary

Langhorne et al (2018)*[15]* conducted a Cochrane review involving nine trials (N=2958 participants) of very early mobilisation (VEM). Data from the AVERT study contributed 2/3 of the data (Bernhardt et al 2015 *[9]*). The median delay to starting mobilisation after stroke onset was 18.5 (13.1 to 43) hours in the VEM group and 33.3 (22.5 to 71.5) hours in the usual care group. In five trials, the VEM group were also reported to have received more mobilisation activity. VEM has similar overall rates of poor outcome (51% versus 49%; OR 1.08, 95% CI 0.92 to 1.26). Death appears slightly more in VEM (8.5% vs 7%) although this was not statistically significant (OR 1.27, 95%CI 0.95 to 1.70). There was no difference in complications but ADL scores were higher (low quality evidence). VEM may lead to reduction in acute hospital LOS (low quality evidence). Effects are robust based on sensitivity analysis by study quality.

Cummings et al (2019)*[16]* reported the prespecified secondary analysis of AVERT for quality of life. No significant different change wsa found in quality of life between early and more frequent mobilisation vs usual care (p=0.86). There was no difference across any of the four QOoL-4D domains.

Rethnam et al (2020)*[14]* conducted an individual participant data (IPD) meta-analysis including six trials (five of the 9 from the Cochrane review and one that was recently published). Out of bed mobilisation commenced at a median 20 hours post stroke compared to 23 hours in the usual care. Favourable outcome at 3 months (mRS 0-2) occurred less often in the VEM group (OR 0.75, 95%CI 0.62-0.92). There was no difference in mortality at 3 months (OR 1.46, 95%CI 0.92-2.31). No difference in ADL (Barthel Index) was found at 3 months (MD 0.16; aOR 1.21, 95%CI 0.71–2.06). Similar to the findings from AVERT VEM may be harmful for patients with severe stroke and haemorrhagic stroke, although this was also not significant in this IPD. Given that VEM and usual care only had a median 3 hours difference in commencing it is possible that increased amount of early mobilisation led to possible harm. In a prespecified analysis of AVERT (Bernhard et al 2016)*[12]* increased daily out-of-bed sessions (keeping time to first mobilization and mobilization amount constant) improved outcome (OR 1.13, 95%CI 1.09 to 1.18). However, increased amount (minutes per day) of mobilization reduced the odds of a good outcome (OR 0.94, 95% CI 0.91 to 0.97). Session frequency was the most important variable in the pre-specified dose-response analysis, after prognostic variables age and baseline stroke severity.

Anjos et al (2022) *[473]* with 104 patients who received thrombolytic treatment observed no significant difference in functional independence (within 7 days of hospitalisation: RR 0.74, 95% CI 0.34 to 1.61, n=104; 90 days after discharge: RR 0.40, 95% CI 0.11 to 0.44, n=54), complications (within 7 days of hospitalisation: RR 1.23, 95% CI 0.48 to 3.17, n=104; 90 days after discharge: RR 0.59, 95% CI 0.10 to 3.54, n=54) and length of stay (median 6.0, IQR 4.0 to 7.0 vs median 5.0, IQR 4.0 to 8.0) when comparing very early mobilization within 24h of the stroke with usual care which was mobilization after 24h.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Very early mobilisation (<24 hrs)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Death or dependency	Odds ratio 1.08 (CI 95% 0.92 — 1.26)	486	507	**Moderate** Due to serious risk	Very early mobilisation (<24 hrs) may increase

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Very early mobilisation (<24 hrs)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
3 months 9 Critical	Based on data from 2,542 participants in 8 studies. [1] (Randomized controlled) Follow up: 3 months.	per 1000 Difference:	per 1000 **21 more per 1000** (CI 95% 21 fewer — 58 more)	of performance bias. Largest and high quality study found increase risk of poor outcome. [2]	the odds of a poor outcome.
Death 3 months 9 Critical	Odds ratio 1.27 (CI 95% 0.95 — 1.7) Based on data from 2,542 participants in 8 studies. (Randomized controlled) Follow up: median 3 months.	68 per 1000 Difference:	85 per 1000 **17 more per 1000** (CI 95% 3 fewer — 44 more)	**Moderate** Due to serious risk of performance bias. Sensitivity analysis suggest increase death with VEM. [3]	Very early mobilisation (<24 hrs) may lead to an increase in death
Any complication 3 months 7 Critical	Odds ratio 0.88 (CI 95% 0.73 — 1.06) Based on data from 2,778 participants in 6 studies. (Randomized controlled) Follow up: 3 months.	224 per 1000 Difference:	200 per 1000 **24 fewer per 1000** (CI 95% 50 fewer — 10 more)	**Low** Due to serious risk of bias, Due to serious imprecision [4]	Very early mobilisation (<24 hrs) may have little or no difference on adverse events
ADL (Barthel Index) median 3 months 7 Critical	High better Based on data from 2,630 participants in 8 studies. (Randomized controlled) Follow up: median 3 months.	Difference:	**MD 1.94 higher** (CI 95% 0.75 higher — 3.13 higher)	**Low** Due to serious risk of bias, Due to serious inconsistency [5]	Very early mobilisation (<24 hrs) may improve ADL (barthel index)
Length of stay 7 Critical	Lower better Based on data from 2,551 participants in 8 studies. (Randomized controlled)	Difference:	**MD 1.44 lower** (CI 95% 2.28 lower — 0.6 lower)	**Low** Due to serious risk of bias, Due to serious inconsistency [6]	Very early mobilisation (<24 hrs) may decrease length of stay slightly

1. Systematic reviewwith included studies: [9]. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Publication bias: no serious.**
3. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
4. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Wide confidence intervals. **Publication bias: no serious.**
5. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Incomplete data and/or large loss to follow up. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:93%.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
6. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:... %.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Strong recommendation

All stroke patients should commence mobilisation (out-of-bed activity) within 48 hours of stroke onset unless otherwise contraindicated (e.g. receiving end-of-life care). (Bernhardt et al. 2015 *[9]*; Lynch et al. 2014 *[10]*)

Practical Info

Patients with baseline NIHSS scores above 4 and below 7 have higher odds of a favourable outcome when they are mobilised more than once per day and spend less than 13.5 minutes per day in out-of-bed activities (Bernhardt et al. 2016 *[12]*). As patients tolerate more out-of-bed activity, it is better to increase the frequency of sessions, rather than the duration of each session. Particular care should be taken to avoid long durations of out of bed activity in people >76 years old and with more severe strokes (NIHSS >7).

There is no rationale for restricting people to bed rest if they are able to move independently.

For patients who have difficulty moving after stroke, an assessment by an appropriately trained health professional as to the most appropriate and safe methods of assisting transfers and out-of-bed activity should be conducted as soon as possible and preferably within 24 hours.

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

There is evidence in a broad sample of participants that mobilising within 48 hours of stroke is associated with a low risk of death and adverse events (Bernhardt et al. 2015 *[9]*). There is moderate evidence that commencing physical rehabilitation within 3 days of stroke reduces complications, and there is no evidence that commencing physical rehabilitation within 3 days is harmful (Lynch et al. 2014 *[10]*).

Certainty of the Evidence

Low

The overall evidence is low, based on a systematic review (Lynch et al. 2014 *[10]*) that included three studies that looked at physical rehabilitation within 3 days of stroke.

Values and preferences

No substantial variability expected

It is usual care in Australia to commence physical rehabilitation for the majority of patients with stroke within 48 hours of stroke, unless they are receiving palliative care.

Resources and other considerations

No important issues with the recommended alternative

<u>Resources considerations</u>

There is evidence that participation in an early exercise and education program may result in favourable long-term outcomes and be cost saving from a hospital perspective (Faulkner et al 2017*[18]*). In a randomised controlled trial conducted in New Zealand, 60 participants were randomised to either an 8-week exercise and education program or to usual care within two weeks of TIA or minor stroke diagnosis. To assess the long term effects of the intervention at 3.5 years post randomisation hospital records were screened. At 3.5 years follow up, participants in the intervention group had fewer recurrent strokes and TIAs, adverse events, deaths than the control group. Hospital admissions costs per person in the intervention group (US$6000 ± 10,000, reference year for costs not stated, data were collected in 2011) were lower than in the control group (US$14,000 ± 15,000). Only costs attributed to emergency department presentation and in-patient admission, obtained from medical records, were included in the cost analysis. A limitation of the economic evaluation was that other factors that may have influenced long-term outcome were not considered e.g. use of secondary prevention interventions.

<u>Implementation and consideration</u>

There is a clinical indicator collected in the National Stroke Audit on whether patients with stroke were mobilised within 24 hours of their admission. There are also clinical indicators collected on the total number of patients with stroke who commenced rehabilitation therapy within 48 hours of their initial assessment and the total number who recieved a

physiotherapy assessment within 48 hours of their presentation to hospital. These latter two clinical indicators are both included in the Acute Stroke Clinical Care Standard.

Rationale

A small number of poor quality studies provides some evidence that mobilisation should commence within 3 days post-stroke. This assessment is based on a systematic review that included three studies (Lynch et al. *[10]*). In a subsequent large, high-quality trial (n = 2104) that included broad sample of participants, mobilising within 48 hours of stroke was associated with a low risk of death and adverse events (Bernhardt et al. 2015 *[9]*).

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Physical rehabilitation (<3 days)
Comparator: Usual care

Summary

Lynch et al (2015) *[10]* conducted a systematic review of early physical rehabilitation studies, including 5 randomised controlled trials and 38 cohort studies. Limited evidence was available regarding rehabilitation started within 3 days of stroke, as only a small randomised trial and two cohort studies directly compared the < 3 day period to later rehabilitation. The randomised trial showed significantly fewer serious complications following early rehabilitation, while the cohort studies reported reduced disability and better ADL function. These studies provide insufficient evidence to determine the benefits of early rehabilitation.

Yen et al 2020 *[20]* explored the efficacy of early mobilisation commenced within 24 to 72 hours of stroke onset in acute intracerebral hemorrhage patients compared to standard rehabilitation (n = 60). Out of bed mobilisation commenced at mean 51.60 hrs (SD 14.15) post stroke compared to 135.02 hours (SD 33.05) for standard rehabilitaiton. The early group showed significant improvement in Functional Independence Measure (FIM-motor score) at all evaluated time points (p = 0.004). Independent walking at 2 weeks and 4 weeks along with shorter length of stay were significantly different favouring the early mobilitation group.

A study by Wang et al (2021)*[21]* with 110 participants with ischaemic stroke found commencing rehabilitation between 24-48 hours after stroke onset was more favourable than commencing between 72-96 hours after stroke onset (aOR 2.27, 95% CI 1.05 to 4.87).

Dromerick et al 2021 (n=72) *[463]* observed a small statistically significant improvement in UL function in acute (<30 days; MD 5.25 ± 2.59) on the ARAT scale but the minimal clinically important difference (MCID) threshold (5.7 points) was not reached. Statistically significant and clinically important improvements were observed in the subacute group (60 to 90 day group; MD 6.87 ± 2.63). There was no difference when compared to control for the >6month group (MD 2.41 ± 2.25). A limitation of this small study is the lack of confidence intervals presented makes assessing treatment effect sizes not possible.

Wang et al (2022) (n=103) *[464]* found no difference for mortality and favourable outcomes at 3 months and 1 year post stroke for early rehabilitation (within 48hrs) compared to conventional rehabilitation in patients who had received mechanical thrombectomy. At three months, there were less people in the early rehabilitation group that had non-fatal complications (OR 3.74, 95% CI 1.604 to 8.718), but at 1 year the incidence was similar (OR 2.31, 95% CI 0.563 to 10.433). Significant differences in activities of daily living between the two groups were observed at 3 months (OR 0.924, 95% CI 0.873 to 0.979) and 1 year (OR 0.951, 95% CI 0.920 to 0.983).

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Physical rehabilitation (<3 days)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Mortality [1]	Based on data from 5,482 participants in 1 studies. (Randomized controlled)	A systematic review collated evidence regarding the effects of starting physical rehabilitation at different time points. 1		**Moderate** Due to serious risk of bias [2]	physical rehabilitation commencing within 3 days of stroke may have little or no difference on

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Physical rehabilitation (<3 days)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
9 Critical	Follow up: in-hospital mortality.	observational study (n=5482) was included that reported on effects on mortality. There was no significant assocation between mobilising within 3 days (vs later than 3 days) and inhospital mortality (1.6% vs 1.7% respectively)			mortality
Disability [3] 3 months 8 Critical	Based on data from 6,292 participants in 4 studies. (Randomized controlled) Follow up: varied between in-hospital to 1 year post-stroke.	Findings from 1 RCT and 3 observational studies investigating the effect of commencing physical rehabilitation within 3 days were synthesised in a systematic review		**Moderate** Due to serious risk of bias [4]	physical rehabilitation commenced within 3 days may improve disability
Functional outcome [5] in hospital 8 Critical	Based on data from 30 participants in 1 studies. (Observational (non-randomized)) Follow up: 3 months.	A small observational study indicated that commencing rehabilitation within 3 days of stroke was associated with better walking ability and activities of daily living function.		**Very low** Due to serious risk of bias as non-randomised [6]	Commencing physical rehabilitation early (<3 days) may increase functional outcome slightly
Complications [7] until hospital discharge 7 Critical	Based on data from 42 participants in 1 studies. Follow up: in hospital.	One small randomised controlled trial (N=42) commencing rehabilitation within 3 days of stroke compared to 7 days post stroke was associated with significant reductions in severe complications (8% vs 47%).		**Moderate** Due to serious imprecision, Due to serious risk of bias [8]	Commencing physical rehabilitation early (<3 days) probably improves complications

1. A systematic review collating evidence about timing of mobilisation after stroke included one cohort study which reported that commencing mobility within 3 days (compared to longer than 3 days) had no significant association with mortality
2. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. Studies examined the effect of timing of commencement of physical rehabilitation on Barthel Index at 3 months
4. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
5. improved walking ability and ADL function
6. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, due to lack of randomisation.
7. 1 RCT with 42 participants provided evidence that commencing rehabilitation at 3 days (compared to 7 days) resulted in significantly fewer complications during the hospital admission
8. **Risk of Bias: serious.** Incomplete data and/or large loss to follow up. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Only data from one study, Low number of patients.

Attached Images

Weak recommendation

For patients with mild and moderate stroke, frequent, short sessions of out-of-bed activity should be provided, but the optimal timing within the 48-hour post-stroke time period is unclear. (Bernhardt et al. 2015 *[9]*)

Practical Info

AVERT investigators conducted a analysis of how the timing and dose of therapy (duration and frequency) affected outcome in different sub-groups of stroke patients (Bernhardt et al 2016*[12]*). The key take home message is that little and often is the best approach. Specifically, they found:

- Younger patients (≤76 years) and those with less severe stroke (NIHSS ≤7.5) were more likely to do well, regardless of the dose of therapy provided.
- Overall increasing session frequency (but not total duration of therapy) reduced the odds of death.
- Patients aged 76-86 years were more likely to do well if they received therapy of no more than 13.5 minutes a day, distributed across several sessions, with a higher frequency of sessions leading to better outcomes.
- Overall there was a 13% improvement in the odds of a favourable outcome for each additional session of out of bed activity provided per day, keeping the total duration of therapy time constant

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

There are no clear benefits around commencing mobilisation very early (less than 24 hours post-stroke) in terms of change in functional outcome, time to unassisted walking or death (Bernhardt et al. 2015 *[9]*). The odds of a favourable outcome (modified Rankin Scale score 0–2) are decreased when mobilisation is commenced very early (less than 24 hours post-stroke) (Bernhardt et al. 2015 *[9]*). On the other hand, there is evidence in a broad sample of participants that mobilising within 48 hours of stroke is associated with a low risk of death and adverse events (Bernhardt et al. 2015 *[9]*).The odds of a favourable outcome are increased when the mobilisation sessions are shorter and more frequent (see practical info section) (Bernhardt et al. 2015 *[9]*).

Certainty of the Evidence

High

The overall quality of evidence against commencing mobilisation very early is high, based on a large randomised controlled trial that included 2104 patients (Bernhardt et al. 2015 *[9]*). The quality of evidence regarding shorter, more frequent sessions is lower, based on data from 2104 patients irrespective of group allocation in a pre-specified subgroup analysis.

Values and preferences

Substantial variability is expected or uncertain

Age and baseline stroke severity should be considered when commencing mobilisation after stroke.

Resources and other considerations

No important issues with the recommended alternative

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

The majority of patients receiving usual care in Australian acute stroke units are mobilised out of bed within 48 hours of stroke onset. There is no evidence to support mobilising earlier than the first 24 hours of stroke, but there is evidence that more frequent, shorter mobility sessions that commence within this 24-hour period are beneficial to patients with stroke, after accounting for baseline stroke severity and age (Bernhardt et al. 2015 *[9]*). There is still uncertainty about the optimal dose (amount and frequency) of out-of-bed activity for people early after stroke.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Very early mobilisation (<24 hrs)
Comparator: Usual care

Summary

Langhorne et al (2018)*[15]* conducted a Cochrane review involving nine trials (N=2958 participants) of very early mobilisation (VEM). Data from the AVERT study contributed 2/3 of the data (Bernhardt et al 2015 *[9]*). The median delay to starting mobilisation after stroke onset was 18.5 (13.1 to 43) hours in the VEM group and 33.3 (22.5 to 71.5) hours in the usual care group. In five trials, the VEM group were also reported to have received more mobilisation activity. VEM has similar overall rates of poor outcome (51% versus 49%; OR 1.08, 95% CI 0.92 to 1.26). Death appears slightly more in VEM (8.5% vs 7%) although this was not statistically significant (OR 1.27, 95%CI 0.95 to 1.70). There was no difference in complications but ADL scores were higher (low quality evidence). VEM may lead to reduction in acute hospital LOS (low quality evidence). Effects are robust based on sensitivity analysis by study quality.

Cummings et al (2019)*[16]* reported the prespecified secondary analysis of AVERT for quality of life. No significant different change wsa found in quality of life between early and more frequent mobilisation vs usual care (p=0.86). There was no difference across any of the four QOoL-4D domains.

Rethnam et al (2020)*[14]* conducted an individual participant data (IPD) meta-analysis including six trials (five of the 9 from the Cochrane review and one that was recently published). Out of bed mobilisation commenced at a median 20 hours post stroke compared to 23 hours in the usual care. Favourable outcome at 3 months (mRS 0-2) occurred less often in the VEM group (OR 0.75, 95%CI 0.62-0.92). There was no difference in mortality at 3 months (OR 1.46, 95%CI 0.92-2.31). No difference in ADL (Barthel Index) was found at 3 months (MD 0.16; aOR 1.21, 95%CI 0.71–2.06). Similar to the findings from AVERT VEM may be harmful for patients with severe stroke and haemorrhagic stroke, although this was also not significant in this IPD. Given that VEM and usual care only had a median 3 hours difference in commencing it is possible that increased amount of early mobilisation led to possible harm. In a prespecified analysis of AVERT (Bernhard et al 2016)*[12]* increased daily out-of-bed sessions (keeping time to first mobilization and mobilization amount constant) improved outcome (OR 1.13, 95%CI 1.09 to 1.18). However, increased amount (minutes per day) of mobilization reduced the odds of a good outcome (OR 0.94, 95% CI 0.91 to 0.97). Session frequency was the most important variable in the pre-specified dose-response analysis, after prognostic variables age and baseline stroke severity.

Anjos et al (2022) *[473]* with 104 patients who received thrombolytic treatment observed no significant difference in functional independence (within 7 days of hospitalisation: RR 0.74, 95% CI 0.34 to 1.61, n=104; 90 days after discharge: RR 0.40, 95% CI 0.11 to 0.44, n=54), complications (within 7 days of hospitalisation: RR 1.23, 95% CI 0.48 to 3.17, n=104; 90 days after discharge: RR 0.59, 95% CI 0.10 to 3.54, n=54) and length of stay (median 6.0, IQR 4.0 to 7.0 vs median 5.0, IQR 4.0 to 8.0) when comparing very early mobilization within 24h of the stroke with usual care which was mobilization after 24h.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Very early mobilisation (<24 hrs)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Death or dependency 3 months 9 Critical	Odds ratio 1.08 (CI 95% 0.92 — 1.26) Based on data from 2,542 participants in 8 studies. [1] (Randomized controlled) Follow up: 3 months.	486 per 1000 Difference:	507 per 1000 **21 more per 1000** (CI 95% 21 fewer — 58 more)	**Moderate** Due to serious risk of performance bias. Largest and high quality study found increase risk of poor outcome. [2]	Very early mobilisation (<24 hrs) may increase the odds of a poor outcome.
Death 3 months 9 Critical	Odds ratio 1.27 (CI 95% 0.95 — 1.7) Based on data from 2,542 participants in 8 studies. (Randomized controlled) Follow up: median 3 months.	68 per 1000 Difference:	85 per 1000 **17 more per 1000** (CI 95% 3 fewer — 44 more)	**Moderate** Due to serious risk of performance bias. Sensitivity analysis suggest increase death with VEM. [3]	Very early mobilisation (<24 hrs) may lead to an increase in death
Any complication 3 months	Odds ratio 0.88 (CI 95% 0.73 — 1.06) Based on data from 2,778 participants in 6 studies. (Randomized controlled)	224 per 1000 Difference:	200 per 1000 **24 fewer per 1000**	**Low** Due to serious risk of bias, Due to serious imprecision [4]	Very early mobilisation (<24 hrs) may have little or no difference on adverse events

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Very early mobilisation (<24 hrs)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
7 Critical	Follow up: 3 months.		(CI 95% 50 fewer — 10 more)		
ADL (Barthel Index) median 3 months 7 Critical	High better Based on data from 2,630 participants in 8 studies. (Randomized controlled) Follow up: median 3 months.	Difference:	**MD 1.94 higher** (CI 95% 0.75 higher — 3.13 higher)	**Low** Due to serious risk of bias, Due to serious inconsistency [5]	Very early mobilisation (<24 hrs) may improve ADL (barthel index)
Length of stay 7 Critical	Lower better Based on data from 2,551 participants in 8 studies. (Randomized controlled)	Difference:	**MD 1.44 lower** (CI 95% 2.28 lower — 0.6 lower)	**Low** Due to serious risk of bias, Due to serious inconsistency [6]	Very early mobilisation (<24 hrs) may decrease length of stay slightly

1. Systematic reviewwith included studies: [9]. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Publication bias: no serious.**
3. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
4. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Wide confidence intervals. **Publication bias: no serious.**
5. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Incomplete data and/or large loss to follow up. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:93%.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
6. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:... %.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Amount of rehabilitation

Understanding the evidence about whether more therapy is better for people after stroke is fraught with issues. The single most important barrier to understanding the dose-response relationship between amount of therapy and outcome is how 'amount of therapy' is defined. Many different systematic reviews have attempted to answer this question, yet all have different ways of defining amount of therapy, or have different outcomes of interest (e.g. upper limb function, walking function, ADL ability or length of hospital stay). This means that different papers are included and direct comparison of results are difficult to make.

We know that time in therapy is a very poor proxy for time engaged in active task practice (Kaur et al. 2013 *[34]*). Yet scheduled therapy time is often the only metric used (Lohse et al. 2014 *[26]*). The meta-data regression paper by Lohse et al. (2014) pulls together data based on time in therapy only and suggests that greater amounts of scheduled therapy time lead to improved outcomes. However, due to the data modelling approach used, equating the results to magnitude of benefit on specific outcomes of interest is not possible. It does however give a robust overall message that more therapy is better.

To add to the complexity, some rehabilitation interventions, such as treadmill training and constraint-induced movement therapy, are designed to provide a greater dose or intensive amount of therapy. It is difficult then to determine if the effect of these interventions are due to the dose or the type of intervention. Where the focus of trials is on a specific named intervention, such as treadmill training or constraint-induced movement therapy, that evidence has been included in relevant sections of these Clinical Guidelines.

There are two broad types of trials that have been considered. First there are trials that have increased the amount of scheduled therapy time provided to stroke survivors, using weekend therapy or group circuit class therapy models of care. Second, there are trials that have provided additional training (more of the same). Often these trials compare 'usual care' and 'usual care plus additional training'. The type of extra training differs between trials. Some systematic reviews have investigated the effect of additional walking training and additional upper limb task-specific training. Therefore this section considers the evidence for additional amount of therapy under the following PICO questions: "What is the effect of increased scheduled therapy time on outcomes after stroke" and "What is the effect of additional specific training on specific outcomes?"

To understand this complex relationship better, future trials need to include specific measures of active practice time (e.g. number of repetitions, time in active task practice, objective physical activity monitoring) for each participant, so that future reviews and data modelling work can better discern the dose-response relationship between active therapy and outcomes.

Note: additional information about amount of rehabilitation for communication (specifically aphasia) has been developed. Please refer to Communication difficulties section.

Strong recommendation

- For stroke survivors, rehabilitation should be structured to provide as much scheduled therapy (occupational therapy and physiotherapy) as possible. (Lohse et al. 2014 *[26]*); Schneider et al. 2016 *[32]*; Veerbeek et al. 2014 *[96]*)
- For stroke survivors, group circuit class therapy should be used to increase scheduled therapy time. (English et al. 2015 *[23]*)

Practical Info

Therapists should seek to maximise the amount of active task practice stroke survivors engage in during therapy sessions. Given that therapists tend to overestimate time spent in active task practice, use of objective measurement of activity (recording repetitions, accelerometers, video analysis of therapy sessions) should be considered. Group circuit class therapy is an efficient way of increasing time spent in therapy (English et al. 2015 *[23]*). Other methods could include use of therapy assistants and family members.

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

There is consistent evidence from systematic reviews (Schneider et al. 2016 *[32]*, Veerbeek et al. 2011 [62]) and meta-regression analyses (Lohse et al. 2014 *[26]*) that increased scheduled therapy time has a small to moderate benefit on improving walking ability, arm function and quality of life (Lohse et al. 2014 *[26]*). There is uncertainty as to the optimal amount of therapy time, related to differences in the actual amount of active therapy time delivered in intervention and control groups. There are no harms reported in relation to increased scheduled therapy time (Lohse et al. 2014 *[26]*).

Certainty of the Evidence

Moderate

The evidence comes from a high-quality meta-regression study (Lohse et al. 2014 *[26]*) and systematic review (Schneider et al. 2016 *[32]*). The evidence for circuit class therapy increasing therapy time comes from a high-quality randomised controlled trial (English et al. 2015 *[23]*). The evidence applies to both upper and lower limb.

Values and preferences

No substantial variability expected

Stroke survivors value physical activity during rehabilitation but report often being bored and alone and having insufficient exercises to do in hospital, however they also express individual preferences as to the mode of therapy delivery (individual versus circuit classes) (Luker et al. 2015 *[35]*).

Resources and other considerations

No important issues with the recommended alternative

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified

Implementation considerations

There is a clinical indicator collected in the National Stroke Audit to determine the total number of patients with stroke who undergo treatment for an identified rehabilitation goal during their acute hospital admission. This clinical indicator is included in the Acute Stroke Clinical Care Standard, with patients excluded if they declined rehabilitation, returned to pre-morbid function, were unresponsive or where treatment was deemed futile. There is also an organisational indicator collected on whether documented processes and systems are in place in participating hospitals to ensure that patients receive evidence-based intensity of therapy related to their goals. Additionally, there is an organisational indicator to ascertain whether patients with motor impairments usually undertake at least one hour of active therapy (physiotherapy or occupational therapy) per day at least five times per week.

Rationale

This recommendation pertains to therapy for improving motor function, including mobility, walking and arm function, predominantly provided by physiotherapists and occupational therapists. For recommendations regarding amount of speech and language therapy see **Aphasia** in the Communications section.

Lohse et al. 2014 *[26]* analysed data based on **time in therapy** only and suggest that greater amounts of scheduled therapy time leads to improved outcomes.

With regards to timing of therapy post-stroke, while providing too much therapy very early (within 24 hours of stroke) may be harmful (see Early mobilisation section in this chapter), most of the papers in the Lohse review included participants at least 2 weeks and up to 5 years post-stroke, and the benefits of increased therapy time were consistent regardless of time post-stroke (Lohse et al. 2014 *[26]*). Twelve (86%) of the 14 papers in the Schneider review included participants within 6 months of stroke (Schneider et al. 2016 *[32]*).

With regards to 5 versus 7 days per week therapy, a recent individual patient data meta-analysis (English et al. 2016 *[33]*) found no benefit of additional weekend therapy was seen with regards to improvements in walking speed or activities of daily living, although weekend therapy may have led to a shorter length of rehabilitation hospital stay. A systematic review of out-of-hours or weekend therapy by Scrivener et al. (2015) *[22]* included seven trials and participants with a range of diagnoses, three of which included only people with stroke. The review found no effect of additional scheduled therapy (out-of-hours or weekend therapy sessions) on physical function or walking speed, but a small postive effect (standardised mean difference 0.1) in ability to perform activities of daily living.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Increased scheduled therapy time
Comparator: Usual care

Summary

Lohse et al (2014) *[26]* conducted a meta-analysis of rehabilitation studies where intervention groups received more total therapy time than control groups. Mean therapy time for control groups was 24 (SD 30) hours and the mean scheduled therapy time in the intervention groups was 57 (SD 45) hours. Meta-analysis showed that additional scheduled therapy is associated with a small effect size in relation to improved function (g=0.35, 95% CI 0.26 to 0.45). A meta-regression analysis that attempted to quantify the degree of benefit predicted from additional therapy time, finding a significant linear association between treatment effect size and the number of additional therapy hours received. Participants in the studies were between 1 day and 5 years post-stroke, and the benefits of increased therapy were similar regardless of time post-stroke.

A nother ~~recently published~~ systematic review found a similar effect size in favour of increased amount of therapy for improving arm activity and mobility (SMD=0.39, 95% CI 0.07 to 0.71), with a larger effect size when only studies with at least 100% increase in therapy time (average 90 minutes additional therapy, 120 minutes total therapy time in the intervention group) were included (SMD 0.59, 95% CI 0.23 to 0.94) (Schneider et al 2016 *[32]*). In this reveiew, 86% of the studies included participants within 6 months of stroke.

Similarly, a systematic review and meta-analysis of trials where intervention groups spent additional time in lower-limb exercise therapy compared to control groups included 14 trials with 725 total participants (Veerbeek et al 2011 *[29]*) showed small to moderate benefits of additional therapy time in walking ability, comfortable and maximum walking speed, and extended activities of daily living, but non-significant differences in basic ADL. Intervention participants received on average an additional 37 minutes of therapy time per day. The meta-analysis found a small but significant benefit for increased walking ability (measured on a range of outocme measures, (SMD 0.32, 95% CI 0.11 to 0.52) and comfortable walking speed (SMD = 0.22, 95% CI 0.01 to 0.43). An in-depth review of the specific interventions delivered in the included studies revealed that of the 80 included trials, 70 (88%) compared either outcomes for participants receiving usual care therapy to those receiving usual care plus additional practice, or low intensity versus high intensity task-specific practice. (English and Veerbeek 2015 *[36]*) Only 10 trials (12%) compared the effect of additional scheduled therapy time, without specifying what people practiced in that time (English and Veerbeek 2015 *[36]*). Thus, the result of this meta-analysis can be considered evidence for the effectiveness of additional active task practice on outcome.

However, other systematic reviews have reported different conclusions. ~~a~~ A Cochrane Review by Clark et al (2021) *[465]* included 21 trials (n=1412 participants). The majority of studies involved upper limb rehabilitation (N=13) with other trials including general rehabilitation (N=5), walking training (N=2), and one lower limb training. Sixteen studies recruited people in the first 6 months post stroke but only 15/76 outcome measure analysis were deemed low risk of bias. When comparing groups that spent more time versus less time in rehabilitation there was no difference found in ADL immediately after intervention (SMD 0.13, 95% CI −0.02 to 0.28; 14 studies, 864 participants; very low-certainty evidence), activity measures of the upper limb immediately after intervention (SMD 0.09, 95% CI −0.11 to 0.29; 12 studies, 426 participants; very low-certainty evidence), and activity measures of the lower limb (SMD 0.25, 95% CI −0.03 to 0.53; 5 studies, 425 participants; very low-certainty evidence). There was an effect for motor impairment measures of the upper limb with more rehabilitation (SMD 0.32, 95% CI 0.06 to 0.58; 9 studies, 287 participants; low-certainty evidence) and of the lower limb (SMD 0.71, 95% CI 0.15 to 1.28; 1 study, n=51 participants; very low-certainty evidence). More rehabilitation did not increase harms (RR 1.20, 95% CI 0.51 to 2.85; 2 studies, 379 participants; low-certainty evidence). Predefined subgroup analyses comparing studies with a larger difference of total time spent in rehabilitation found greater improvements for studies with a larger difference which was statistically significant for ADL outcomes (P = 0.02) and activity measures of the upper limb (P = 0.04), but not for activity measures of the lower limb (P = 0.41) or motor impairment measures of the upper limb (P = 0.06). ~~nother systematic review by Hayward et al (2014) *[27]* assessing the effects of changing single components of rehabilitation interventions included 9 trials that manipulated the dose or intensity of therapy, found no significant differences in function in a meta-analysis (MD -0.30, 95% CI -2.20 to 1.60). The differences in type of intervention between the pooled studies may have influenced results, as may the timing post-stroke at which interventions were delivered.~~ Hayward et al (2021) *[458]* included 228 studies (174 RCT & 54 other study designs) specifically for upper limb therapy (9704 participants in all studies). Most studies (62%) were rated high risk of bias and most (176) were in the early subacute period (8-90 days). The overall intervention groups had a median total intervention dose of 900min (IQR 600 to 1430mins) involving median session lengths of 45 min, once per day, 5 days a week, for 4 weeks. It is likely the daily therapy dose is too small to improve motor recovery and most of the interventions tested did not result in a difference in m inimal clinical important difference. A meta-analysis of 23 trials of constraint-induced movement therapy found significant improvements in arm motor function and arm motor activity overall. However, meta-regression found no significant effect of treatment duration (Thrane et al 2014 *[235]*). ~~The CIRCIT randomised trial (English et al 2015 *[23]*) compared usual care, usual care delivered 7 days a week, and circuit class therapy 5 days a week. Both weekend therapy and circuit class therapy increased scheduled therapy time, with much larger effects (22 hours in 4 weeks) for circuit class therapy compared to weekend therapy (3 hours in 4 weeks) without the need to increase staffing resources. However, there were no significant differences between groups in walking ability.~~

In summary, we still don't know what the threshold of active therapy is to provide benefit. Evidence from animal studies

suggests it is much higher than what is currently provided in clinical practice.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Increased scheduled therapy time	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Various function and impairment measures - pooled [1] Variable - end of of treatment estimates 7 Critical	Based on data from 2,284 participants in 34 studies. (Randomized controlled) Follow up: End of treatment.	Pooling data from 34 trials, there was a significant benefit for people receiving more therapy time compared to less (standardised effect size g=0.35; 95% CI 0.26 to 0.45 indicating moderate effect size). This finding is difficult to interpret in terms of benefit for specific outcomes (eg walking ability, upper limb function, health related quality of life), as it represents pooling across all reported outcome measures. The mean amount of therapy time scheduled for people in the intervention groups was 57 hours compared to 24 hours in the control groups. The benefit of increased therapy time remained, even when controlling for time after stroke.		**Moderate** Due to serious risk of bias [2]	Increased scheduled therapy time probably improves various function and impairment measures

1. The meta-analysis computed standardised effect sizes from studies using different outcome measures. The measures included were limited to "validated behavioral measures of function or impairment" Effect sizes (Hedges g) from individual studies computed from terminal differences in treatment and control groups or differences in change scores between treatment and control divided by SD within groups.
2. **Risk of Bias: serious.** overall quality of included papers in the meta-regression was moderate. **Inconsistency: no serious. Indirectness: no serious.** test for heterogeneity was not significant. **Imprecision: no serious.** relatively narrow confidence intervals around the effect size (0.26 to 0.45). **Publication bias: no serious. Upgrade: clear dose-response gradient.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Circuit therapy
Comparator: 5-day week therapy (usual care)

Summary

A large multi-centre 3-armed randomised controlled trial, n=283 (English et al 2015 *[23]*) included participants admitted to inpatient rehabilitation facilities after stroke and compared the effectiveness of physiotherapy delivered in group circuit class therapy to usual care physiotherapy (5 days a week) and 7-day week usual care physiotherapy. The primary outcome was walking ability using the six minute walk test, and no statistically signficant between group differences were found (data extraced for the circuit class therapy and usual care [5 days a week] group). Providing physiotherapy in group circuit classes was highly effective at increasing the time participants spent in physiotherapy sessions (mean difference for total therapy time 22.2 hours, 95% CI 19.1 to 25.3 compared to usual care 5 days a week) (English et al 2014 *[37]*). Video analysis of a subset of therapy sessions showed that despite the increased time in therapy sessions, the amount of walking practice was not different between groups (English et al 2014 *[33]*).

Outcome Timeframe	**Study results and measurements**	**Comparator** 5-day week therapy (usual care)	**Intervention** Circuit therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Distance walked on the six minute walk test [1] Four weeks post-randomisation 8 Critical	Measured by: Six minute walk test High better Based on data from 283 participants in 1 studies. (Randomized controlled) Follow up: Four weeks.	105.5 metres (Median) Difference:	116 metres (Median) **MD 10.5 higher** IQR	**Moderate** Due to serious imprecision [2]	Circuit class therapy probably has little or no difference on distance walked on the six minute walk test
Time in therapy During inpatient rehabilitation up to 4 weeks 7 Critical	Measured by: Total therapy time during inpatient stay High better Based on data from 283 participants in 1 studies.	15.1 (Mean) Difference:	37.3 (Mean) **MD 22.2 higher** (CI 95% 19.1 higher — 75.1 higher)	**High** Due to serious imprecision, Upgraded due to Large magnitude of effect [3]	Circuit class therapy increases time in therapy

1. The six minute walk test is a valid and reliable measure of walking capacity and previous trials have demonstrated that circuit class therapy is particularly effective for improving walking capacity after stroke.
2. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Only data from one study, Difference between groups was not statistically significant.. **Publication bias: no serious.**
3. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Only data from one study. **Publication bias: no serious. Upgrade: large magnitude of effect.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Additional active practice
Comparator: Usual care

Summary

Schneider et al (*[32]*) pooled data from 14 studies (954 participants) in which extra therapy of the same type was provided. This included studies that focussed on upper limb activity, walking ability or a combination. They found a beneficial effect of increased therapy time for improving activity (upper limb and lower limb combined, SMD 0.39, 95% CI 0.07 to 0.71, I2=66%)). When the experimental group received at least double the amount of therapy time, the effect size increased and statisticaly heterogeneity decreased (SMD 0.59, 95% CI 0.23 to 0.94, I2=44%). Hayward et al (2014) *[27]* pooled data from nine studies that specifically compared interventions focussed on improving arm function in which only the amount (dose) of therapy was different between groups. Between 2 and 7 hours a week of additional therapy was provided to intervention participants. Outcomes were pooled for both activities of daily living and arm function together and no effect was found (SMD -0.30, 95% CI -2.2 to 1.6). Pooled data for arm function and activities of daily living separately are not reported, and the heterogeneity in the analysis was very high (I2 93%). The differences in types of intervention between the pooled studies may have influenced results, as may the timing post-stroke at which interventions were delivered. Findings of a recent large randomised controlled trial (iCARE) are consistent with these findings with no additional benefit found from doubling therapy dose of arm motor therapy (Winstein et al 2016 *[31]*). However, the increased therapy dose of 28 hours may still be sub-threshold.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Additional active practice	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Activities of daily living 8 Critical	Measured by: Variety of ADL scales High better Based on data from 3,064 participants in 36 studies. [1] (Randomized controlled) Follow up: Post intervention.	Difference:	**SMD 0.22 higher** (CI 95% 0.09 higher — 0.34 higher)	**Moderate** The effect sizes were small. The difference in dosage (amount of extra therapy) was not well reported in studies, making direct comparisons between trials difficult. [2]	Additional active practice probably improves activities of daily living
Walking ability Immediate treatment effects 8 Critical	Measured by: Comfortable walking speed Scale: 0 — 1.4 High better Based on data from 1,097 participants in 22 studies. (Randomized controlled)	Difference:	**SMD 0.29 higher** (CI 95% 0.17 higher — 0.41 higher)	**High** The difference in dosage (amount of extra therapy) was not well reported in studies, making direct comparisons between trials difficult. Consistent favourable findings were reported for both comfortable and maximal walking speed, but not walking distance or walking ability (general scales). [3]	Additional active practice improves walking speed
Arm function and walking ability [4] End of intervention 7 Critical	Based on data from 954 participants in 14 studies. (Randomized controlled) Follow up: End of intervention.	Pooled data from 14 studies for both arm function and walking ability together found beneficial effect (SMD 0.39, 95% CI 0.07 to 0.71). This was higher when only studies with at least 100% increase in therapy time were included (SMD 0.59, 95% CI 0.23 to 0.94).		**Moderate** Many of the included studies had small sample size and the statistical heterogeneity was high (66%) [5]	Additional active practice probably improves arm function and walking ability

1. Systematic review [216] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Inconsistency: no serious.** The magnitude of statistical heterogeneity was moderate, with I^2: 62%.. **Indirectness: no serious.** The differences in dosage between the different trials were not well reported. **Imprecision: no serious.** small effect sizes. **Publication bias: no serious.**
3. **Risk of Bias: no serious.** Range of quality of included studies in overall meta-analysis. Risk of bias for studies included in the walking speed meta-analysis only not separately reported. **Inconsistency: no serious.** Effect size for walking speed was homogenous. **Indirectness: no serious.** Direct comparisons not available. **Imprecision: no serious.** Wide confidence intervals but consistent findings for both comfortable and maximal walking speed. **Publication bias: no serious.**
4. Pooled data from 14 studies for both arm function and walking ability together found beneficial effect (SMD 0.39, 95% CI 0.07 to 0.71). This was higher when only studies with at least 100% increase in therapy time were included (0.59, 95% CI 0.23 o 0.94).
5. **Risk of Bias: no serious.** Missing intention-to-treat analysis in 60% of included papers. **Inconsistency: no serious.** The magnitude of statistical heterogeneity was high, with I^2: 66%. This dropped to 44% when only trials with a high treatment contrast were included.. **Indirectness: no serious. Imprecision: serious.** Low number of patients in many of the included trials.. **Publication bias: no serious.**

Attached Images

Good practice statement

Consensus-based recommendation
Stroke survivors should be encouraged to continue with active task practice outside of scheduled therapy sessions. This could include strategies such as:

- self-directed, independent practice;
- semi-supervised and assisted practice involving family/friends, as appropriate.

Weak recommendation

A minimum of three hours a day of scheduled therapy (occupational therapy and physiotherapy) is recommended, ensuring at least two hours of active task practice occurs during this time. (Lohse et al. 2014 *[26]*; Schneider et al. 2016 *[32]*)

Practical Info

There is no direct evidence that people with fatigue and/or attention and concentration issues would not benefit from the same amount of scheduled therapy and active task practice time. However, not all stroke survivors will tolerate this amount of therapy. Strategies to maximise therapy time within tolerance limits may include reducing background distractions and noise, introducing frequent rests and scheduling several shorter therapy sessions across the day.

Evidence To Decision

Benefits and harms

There is uncertainty about the benefits of increased scheduled therapy time on improving walking ability, arm function and quality of life (Lohse et al. 2014 *[26]*). This may be related to differences in the actual amount of active therapy time delivered in intervention and control groups. A more recent systematic review (Schneider et al. 2016 *[32]*) found consistent improvements in function related to increased therapy time for both upper and lower limb function. There are no harms reported in relation to increased scheduled therapy time (Lohse et al. 2014 *[26]*, Schneider et al. 2016 *[32]*).

Rationale

The recommended 3 hours per day of therapy is based on a mean 57 hours in the paper by Lohse et al. 2014 *[26]*, delivered 5 days a week over 4 weeks. This is consistent with a large, 3-armed multicentre randomised controlled trial (English et al. 2015 *[23]*), which found that 3 hours of physiotherapy per day delivered in group circuit classes was safe and feasible within existing staffing resources.

However, therapy time is a poor proxy for time spent in actual active task practice (Kaur et al. 2013 *[34]*). A more recent systematic review (Schneider et al. 2016 *[32]*) included 14 studies (954 participants) and found that at least 240% more ***active therapy time*** was needed before benefits were seen. This equated to an average of 2 hours a day of active motor training (mean usual care therapy time 25 minutes, mean additional therapy time 90 minutes).

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Additional active practice
Comparator: Usual care

Summary

Schneider et al (*[32]*) pooled data from 14 studies (954 participants) in which extra therapy of the same type was provided. This included studies that focussed on upper limb activity, walking ability or a combination. They found a beneficial effect of increased therapy time for improving activity (upper limb and lower limb combined, SMD 0.39, 95% CI 0.07 to 0.71, I2=66%)). When the experimental group received at least double the amount of therapy time, the effect size increased and statisticaly heterogeneity decreased (SMD 0.59, 95% CI 0.23 to 0.94, I2=44%). Hayward et al (2014) *[27]* pooled data from nine studies that specifically compared interventions focussed on improving arm function in which only the amount (dose) of therapy was different between groups. Between 2 and 7 hours a week of additional therapy was provided to intervention participants. Outcomes were pooled for both activities of daily living and arm function together and no effect was found (SMD -0.30, 95% CI -2.2 to 1.6). Pooled data for arm function and activities of daily living separately are not reported, and the heterogeneity in the analysis was very high (I2 93%). The differences in types of intervention between the pooled studies may have influenced results, as may the timing post-stroke at which interventions were delivered. Findings of a recent large randomised controlled trial (iCARE) are consistent with these findings with no additional benefit found from doubling therapy dose of arm motor therapy (Winstein et al 2016 *[31]*). However, the increased therapy dose of 28 hours may still be sub-threshold.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Additional active practice	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Activities of daily living 8 Critical	Measured by: Variety of ADL scales High better Based on data from 3,064 participants in 36 studies. [1] (Randomized controlled) Follow up: Post intervention.	Difference:	**SMD 0.22 higher** (CI 95% 0.09 higher — 0.34 higher)	**Moderate** The effect sizes were small. The difference in dosage (amount of extra therapy) was not well reported in studies, making direct comparisons between trials difficult. [2]	Additional active practice probably improves activities of daily living
Walking ability Immediate treatment effects 8 Critical	Measured by: Comfortable walking speed Scale: 0 — 1.4 High better Based on data from 1,097 participants in 22 studies. (Randomized controlled)	Difference:	**SMD 0.29 higher** (CI 95% 0.17 higher — 0.41 higher)	**High** The difference in dosage (amount of extra therapy) was not well reported in studies, making direct comparisons between trials difficult. Consistent favourable findings were reported for both comfortable and maximal walking speed, but not walking distance or walking ability (general scales). [3]	Additional active practice improves walking speed
Arm function and walking ability [4] End of intervention 7 Critical	Based on data from 954 participants in 14 studies. (Randomized controlled) Follow up: End of intervention.	Pooled data from 14 studies for both arm function and walking ability together found beneficial effect (SMD 0.39, 95% CI 0.07 to 0.71). This was higher when only studies with at least 100% increase in therapy time were included (SMD 0.59, 95% CI 0.23 to 0.94).		**Moderate** Many of the included studies had small sample size and the statistical heterogeneity was high (66%) [5]	Additional active practice probably improves arm function and walking ability

1. Systematic review [216] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Inconsistency: no serious.** The magnitude of statistical heterogeneity was moderate, with I^2: 62%.. **Indirectness: no serious.** The differences in dosage between the different trials were not well reported. **Imprecision: no serious.** small effect sizes. **Publication bias: no serious.**
3. **Risk of Bias: no serious.** Range of quality of included studies in overall meta-analysis. Risk of bias for studies included in the walking speed meta-analysis only not separately reported. **Inconsistency: no serious.** Effect size for walking speed was homogenous. **Indirectness: no serious.** Direct comparisons not available. **Imprecision: no serious.** Wide confidence intervals but consistent findings for both comfortable and maximal walking speed. **Publication bias: no serious.**
4. Pooled data from 14 studies for both arm function and walking ability together found beneficial effect (SMD 0.39, 95% CI 0.07 to 0.71). This was higher when only studies with at least 100% increase in therapy time were included (0.59, 95% CI 0.23 o 0.94).
5. **Risk of Bias: no serious.** Missing intention-to-treat analysis in 60% of included papers. **Inconsistency: no serious.** The magnitude of statistical heterogeneity was high, with I^2: 66%. This dropped to 44% when only trials with a high treatment contrast were included.. **Indirectness: no serious. Imprecision: serious.** Low number of patients in many of the included trials.. **Publication bias: no serious.**

Attached Images

Early supported discharge services

Early supported discharge (ESD) is a model that links inpatient care with community services and provision of rehabilitation services within the home environment, with the aim of reducing the length of stay. ESD services should be considered an extension of stroke unit care rather than an alternative. A key argument for ESD is that the home provides an optimum rehabilitation environment since the goal of rehabilitation is to establish skills that are appropriate to the home setting. To work effectively, ESD services must have similar elements to those of organised stroke teams. The level of services available following discharge from hospital can be limited, and stroke survivors and their families/carers often report being dissatisfied with the information, support services and therapy available. Therefore, while there is great pressure to ensure early discharge from acute services, the evidence is based on early **supported** discharge, i.e. not just **early** discharge, and it is vital to ensure that adequate community services for rehabilitation and carer support services, mirroring those used in the trials, are developed and utilised. Despite good evidence of its effectiveness, patients in Australia are rarely referred to ESD services and have limited access to an ESD stroke specialist team (Stroke Foundation 2020 *[8]*).

Strong recommendation

Where appropriate home-based coordinated stroke services are available (*see Practical information section*), early supported discharge services should be offered to stroke patients with mild to moderate disability. (Langhorne et al. 2017 *[39]*)

Practical Info

To work effectively, ESD services must have similar elements to those of organised stroke teams (see stroke unit care). Typical ESD teams had approximately 3.1 full-time equivalent (FTE) staff (range 2.6 to 4.6) as follows: medical 0.1, nursing (ranged from 0 to 1.2), physiotherapy 1.0, occupational therapy 1.0, speech and language therapy 0.3, assistant 0.4, social work (0 to 0.5 FTE) and secretarial support (Langhorne et al. 2017 *[39]*). Patients tended to be a selected elderly group with moderate disability (Barthel Index [BI] scores between 10 to 18 points). Most trials were conducted in the urban centres of the United Kingdom, so there may be subtle differences in care in the Australian context.

Trials of ESD suggest 15% of patients may be eligible based on objective measure of both physical and cognitive function e.g. BI scores of 16 to 19 and an MMSE greater than 23, in addition to caregiver availability, suitability of the home environment, and proximity to the hospital. Furthermore, the average patient age in the trials ranged from 60 to 80 years (Langhorne et al 2017 *[39]*). While ESD services are not widely available in Australia the inclusion and impact specifically on people with stroke <65 years requires consideration. Working aged people with stroke may exhibit less physical disability, but often experience significant cognitive challenges, and tend to have specific needs in relation to returning to work, parenting and psychosocial aspects of recovery, yet often don't receive rehabilitation services within 3 months of their stroke (Walters et al 2020 *[49]*).

Studies suggest ESD service will require 4-5 weeks on average to be effective (Meyer et al 2016 *[45]*).

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

In the Cochrane review by Langhorne et al. (2017) *[39]*, participants receiving early supported discharge (ESD) services showed significant reductions (P < 0.0001) in the length of hospital stay equivalent to approximately six days. ESD also resulted in reduced odds of death or dependency which equated to five fewer adverse outcomes per 100 patients. ESD also reduced the outcome of death or institutional care, and extended activities of daily living scores and level of patient satisfaction. Benefits were less at one and five year follow-up. Rate of readmission to hospital was no different between ESD and conventional services groups. The greatest benefits were seen in the trials evaluating a coordinated ESD team and in stroke patients with mild to moderate disability.

Certainty of the Evidence

Moderate

The quality of the evidence was rated moderate by Langhorne et al 2017 *[39]* for most outcomes but low for extended ADL, satisfaction and readmission. Evidence was downgraded primarily due to potential performance bias (patients and staff aware of treatment allocation), however, senstivity analysis indicated little risk from other potential biases. It was the view of the working group that further trials were unlikely to effect the overall certainty of effects and are robust.

Values and preferences

No substantial variability expected

ESD is likely to be consistently preferred than conventional therapy given reduced risk of being dependent and in institutional care, and greater patient satisfaction. There are no real adverse outcomes with ESD, however, some patients and their family may have reservations with leaving hosptial early. But trials have found no difference in carers' subjective health status, mood or satisfaction.

Resources and other considerations

No important issues with the recommended alternative

Resources considerations

There is some evidence that ESD may be cost-effective or provide a viable alternate model of care to management on a general ward. In a Cochrane review (Langhorne et al. 2017 *[39]*) conducted to investigate services such as ESD with rehabilitation at home for reducing duration of hospital care for patients with acute stroke, costs from seven trials ranged from 23% less to 15% greater for the ESD group in comparison to controls, and these estimates were reported to be stable in sensitivity analyses. This is consistent with evidence from economic evaluations conducted parallel to randomised controlled trials. In a single-centre randomised controlled trial conducted in the United Kingdom, patients were randomised to receive care in a stroke unit (n=152), or in a general ward (n=152) or domiciliary care (n=153) within 72 hours of stroke onset (Patel et al. 2004 *[42]*). While more effective than domiciliary care, care in a stroke unit cost an additional £64,097 to £136,609 per QALY gained when compared to domiciliary care (cost reference year 1997–1998), but domiciliary care produced greater health gains for lower costs than care in a general ward. In another single-centre randomised controlled trial (n=320) comparing stroke unit care and stroke unit care with ESD in Norway (Fjaertoft et al. 2005 *[43]*) and fewer deaths and nursing home admissions at 5 years post-stroke, patients provided ESD had lower costs at 12 months (EUR 18,937 vs EUR 21,824) (Fjaertoft et al. 2005 *[43]*) and fewer deaths and nursing home admissions at 5 years post-stroke (Fjaertoft et al. 2011 *[47]*) than the control group (cost reference year not mentioned, data were collected from 1995-1997).

Other evidence in support of ESD comes from observational comparative-effectiveness studies such as one conducted in Sweden
(Tistad and von Koch 2015 *[44]*), in which patients who had received the ESD service (n=40) were compared to those eligible for ESD but had received conventional inpatient rehabilitation (n=110). Only costs of healthcare services utilised during the first year after stroke were included and were obtained from an administrative database. At 12 months post stroke, the mean cost per person was SEK 260,425 in the ESD group and SEK 287,964 in the non ESD group (cost reference year 2012). Comparable findings have also been reported from a study conducted in Canada (n=100) (Tam et al 2018*[48]*), in which patients who were 'fast-tracked' to receive high-intensity outpatient rehabilitation commencing within a week of discharge after stroke were compared to a simulated cohort of patients who were not 'fast-tracked' (remaining in acute or receiving inpatient rehabilitation). Costs from a healthcare perspective were included, with administrative patient-level data used to obtain the cost estimates (cost reference year 2016). Per additional inpatient day saved, the 'fast-tracked' program cost an additional CAN$37 (95% CI: CAN$20–55) for patients who were discharged from acute care and an additional CAN$404 (95% CI: CAN$$270–620) for those discharged from inpatient rehabilitation. This was cheaper than the cost of an additional inpatient bed day (CAN$698). A limitation of the economic evaluation was that other relevant costs (for example transportation to and from out-patient rehabilitation, and cost to patients and their caregivers), which may be important, were not included in this analysis.

Implementation considerations

There are clinical indicators collected in the National Stroke Audit on the number of patients referred to ESD and the proportion of those that go on to access the service. There is also an organisational indicator collected to determine whether hospitals have ongoing access to stroke-specialist ESD.

Rationale

Early supported discharge (ESD) with well-organised discharge teams and coordinated community support showed overall benefit for stroke patients with mild to moderate disability, based on a meta-analysis of 16 trials (N = 2359) (Langhorne et al. 2017 *[39]*). The updated patient data analysis demonstrated that patients receiving ESD services were more likely to be independent and living at home six months after stroke than those who received conventional services. The overall quality of the trials was moderate to high, so we have confidence in these results.

Clinical Question/ PICO

Population: Adults with stroke

Intervention: Early supported discharge services
Comparator: Conventional care

Summary

A Cochrane review by Langhorne et al (2017) *[39]* included 17 trials (N = 2422) comparing conventional care to interventions providing community-based rehabilitation and support and aiming to reduce the duration of hospital care. Overall, ESD services were associated with a significant reduction in death or dependency at the end of median 6 month follow-up (OR 0.80, 95% CI 0.67 to 0.95), significant reduction of death or institutionalisation (OR 0.75, 95% CI 0.59 to 0.96) and significantly reduced length of intial hospital stay by approximately 6 days. There was more satisfaction from patients provided ESD who also had higher extended ADL scores. There was no difference in mortality or readmissions to hospital. In subgroup analyses those services with a multidisciplinary team (MDT) providng active community rehabilitation was found to be more effective than services that just coordinated services without providing full MDT input.

A subsequently published study (Rafsten et al 2019 *[46]*) reported significantly improved level of disability at 3 months (p=0.0004) which became non-significant at 12 months. No difference in anxiety was found at any time point.

Outcome Timeframe	**Study results and measurements**	**Comparator** Conventional care	**Intervention** Early supported discharge service	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Death 9 Critical	Odds ratio 1.04 (CI 95% 0.77 — 1.4) Based on data from 2,116 participants in 16 studies. (Randomized controlled) Follow up: median 6 months.	90 per 1000 Difference:	93 per 1000 **3 more per 1000** (CI 95% 19 fewer — 32 more)	**Moderate** Downgraded due to potential performance bias [1]	ESD services in general probably have little or no difference on death
Death or requiring institutional care 9 Critical	Odds ratio 0.75 (CI 95% 0.59 — 0.96) Based on data from 1,664 participants in 12 studies. (Randomized controlled) Follow up: median 6 months.	270 per 1000 Difference:	217 per 1000 **53 fewer per 1000** (CI 95% 91 fewer — 8 fewer)	**Moderate** Downgraded due to potential performance bias [2]	ESD services in general decrease death or requiring institutional care
Death or dependency 9 Critical	Odds ratio 0.8 (CI 95% 0.67 — 0.95) Based on data from 2,359 participants in 16 studies. (Randomized controlled) Follow up: median 6 months.	450 per 1000 Difference:	396 per 1000 **54 fewer per 1000** (CI 95% 96 fewer — 13 fewer)	**Moderate** Downgraded due to potential performance bias [3]	ESD services in general decrease death or dependency
Satisfaction with services 8 Critical	Odds ratio 1.6 (CI 95% 1.08 — 2.38) Based on data from 513 participants in 5 studies. (Randomized controlled) Follow up: median 6 months.	610 per 1000 Difference:	715 per 1000 **104 more per 1000** (CI 95% 18 more — 178 more)	**Low** Downgraded twice for risk of performance bias and potential risk of missing data [4]	ESD services in general improve satisfaction with services
Readmission 7 Critical	Odds ratio 1.09 (CI 95% 0.79 — 1.51) Based on data from 784 participants in 6 studies.	250 per 1000	270 per 1000	**Low** Downgraded twice for risk of performance bias	ESD service may have little or no difference on readmission

Outcome Timeframe	**Study results and measurements**	**Comparator** Conventional care	**Intervention** Early supported discharge service	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
	(Randomized controlled) Follow up: median 6 months.	Difference:	**17 more per 1000** (CI 95% 42 fewer — 85 more)	and potential risk of missing data [5]	
Extended activities of daily living (EADL) score 8 Critical	Measured by: EADL High better Based on data from 1,262 participants in 11 studies. (Randomized controlled) Follow up: median 6 months.	Difference:	**SMD 0.14 higher** (CI 95% 0.03 higher — 0.25 higher)	**Low** Downgraded twice for risk of performance bias and potential risk of missing data [6]	ESD services in general slightly improve extended activities of daily living
Length of stay	Measured by: Length of stay High better Based on data from 2,161 participants in 16 studies. (Randomized controlled)	Difference:	**MD 5.5 lower** (CI 95% 2.9 lower — 8.2 lower)	**Moderate** Downgraded due to potential performance bias [7]	ESD service probably decreases length of stay

1. **Risk of Bias: serious.** Lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Wide confidence intervals. **Publication bias: no serious.**
2. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. **Risk of Bias: no serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
4. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Incomplete data and/or large loss to follow up. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Wide confidence intervals. **Publication bias: no serious.**
5. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
6. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Incomplete data and/or large loss to follow up. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
7. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Wide confidence intervals. **Publication bias: no serious.**

Attached Images

Home-based rehabilitation

Home-based rehabilitation is different to early supported discharge. Stroke rehabilitation for people living in the community is commonly delivered either in a centre, outpatient or day hospital setting (Hillier 2000 *[53]*), although referral to community rehabilitation offered in the home is increasing (Stroke Foundation 2019 *[7]*). In the National Stroke Audit of Acute Services, 10% of patients were referred to home-based community rehabilitation (Stroke Foundation 2019 *[7]*), while in the National Stroke Audit of Rehabilitation Services, this increased to 24% (Stroke Foundation 2020 *[8]*). On the other hand, 68 out 111 (61%) surveyed in the National Stroke Audit of Rehabilitation Services reported having access to community-based rehabilitation provided in the home (Stroke Foundation 2020 *[8]*). Stroke survivors report a strong preference for undertaking rehabilitation in the home and it has been shown to increase carer satisfaction and may lower risk of readmission (Crotty et al. 2008).

Weak recommendation

Home-based rehabilitation may be considered as a preferred model for delivering rehabilitation in the community. Where home rehabilitation is unavailable, stroke patients requiring rehabilitation should receive centre-based care. (Rasmussen et al. 2016 *[51]*; Hillier et al. 2010 *[53]*)

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

One review found benefits related to function in short term and quality of life, but benefits were small, particularly for function (Hillier et al. 2010 *[53]*). An additional study showed that 3 months after stroke, patients undergoing rehabilitation at home were less disabled and experienced a higher quality of life than patients receiving standard care (Rasmussen et al. 2016 *[51]*). Patients trained at home achieved better modified Rankin Scale and EuroQol-5D scores. Additionally, three months after stroke the total amount of home-based training in minutes positively correlated with modified Barthel ADL index, Motor Assessment Scale and EuroQol-5D scores, and negatively correlated with the modified Rankin Scale scores. The chosen home-based rehabilitation scheme was more effective than the existing rehabilitation services and did not increase rehabilitation costs. Overall, the authors' results suggested that early supported discharge teams should start acting before discharge by training inpatients at home.

Certainty of the Evidence

Low

Included studies have some risk of bias and overall quality is rated as low.

Values and preferences

No substantial variability expected

Home-based rehabiliation is preferred by the majority of stroke patients.

Resources and other considerations

No important issues with the recommended alternative

<u>Economics considerations</u>

There is some evidence that home based rehabilitation may be cost saving and more effective compared to standard inpatient rehabilitation care. In an economic evaluation conducted parallel to a randomised controlled trial in Denmark, home-based rehabilitation (n=38) was compared to standard inpatient rehabilitation care (n=33) (Rasmussen et al. 2016 *[51]*). Quality of life was assessed using the EuroQol-5D and costs related to the delivery of the intervention and the hospital admission were collected. At 90 days post stroke, participants in the intervention group had better modified Rankin Scale scores and greater quality of life. The average total cost was US$54,118 for patients provided home-based rehabilitation and US$54,242 for patients provided standard care (cost reference year not reported, data were collected in 2011). There were similar findings from an economic evaluation in which a home-based rehabilitation programme provided in Canada was compared to usual care where patients had limited access to specialist rehabilitation (Allen et al 2018*[62]*). Home-based rehabilitation was provided to survivors of stroke by a multidisciplinary team over multiple visits. Costs to the healthcare sector and QALYs were modelled over a lifetime using data collected from patients receiving the home-based rehabilitation programme at baseline and 12 months follow-up and data from several other sources. It was estimated that ongoing rehabilitation at home would be less

costly and more effective than usual outpatient rehabilitation (cost savings of $US 17,255 and 1.65 QALYs gained). The reference year for costs were not reported (data were collected from 2012-2013).

Implementation considerations
There are clinical indicators collected in the National Stroke Audit on the number of patients referred to home-based community rehabilitation and the proportion of those that go on to access the service. There is also an organisational indicator collected to determine whether hospitals have ongoing access to community-based rehabilitation provided in the home.

Rationale

Home-based rehabilitation resulted in a small improvement in short-term functional independence compared with centre-based rehabilitation, but little or no difference for medium-term functional independence. Home-based rehabilitation may improve quality of life and disability, however the findings were based on data from one study (N = 61) *[51]*.

Clinical Question/ PICO

Population:	Community-dwelling adults with stroke
Intervention:	Home-based rehabilitation provided by therapist in person
Comparator:	Community-based rehabilitation by therapist in person

Summary

Hillier et al (2010) *[53]* compared outcomes from home-based and centre-based rehabilitation for people living in the community following stroke in a systematic review and meta-analysis. Centre-based rehabilitation was delivered in settings such as outpatient clinics or day hospitals. Eleven randomised controlled trials were included, with most reporting Barthel Index scores as a measure of overall functioning or activity. Meta-analysis showed significantly increased Barthel Index scores at 3 months for home-based rehabilitation (MD 1 point, 95% CI 0.12 to 1.88), with non-significant differences at 6 months. A subsequent randomised trial by Rasmussen et al (2016) *[51]* assessed quality of life and disability outcomes among patients (n = 71) randomly assigned to home-based or standard care. The trial commenced during hospitalisation. Standard care included inpatient rehabilitation with therapy provided by the multidisclinary team 5 days a week. Intervention participants received in-home rehabilitation 1 to 3 days a week during hospitalisation, and 1 to 5 days a week post-discharge. Details about standard care after discharge was not provided. Quality of life, assessed using EuroQol-5D, was significantly improved in the home-based rehabilitation group (Intervention median 0.77, IQR 0.66 to 0.79; Control median 0.66, IQR 0.56 to 0.72; P=0.03), as was disability measured using the modified Rankin scale (Intervention median 2, IQR 2 to 3; Control median 3, IQR 2 to 4; P=0.04).

A systematic review by Doig et al (2010) *[52]* included trials comparing home-based and hospital-based rehabilitation for patients with acquired brain injury, including 17 studies, 15 of which included stroke patients. Meta-analysis was not performed, but the review found that home-based rehabilitation appeared to be at least equivalent to hospital-based care in improving impairment and activity limitations.

Mandigout et al (2021)*[68]* (n=83) observed no difference between home based rehabilitation involving physical activity programme at home together with telephone calls regularly and use of activity tracker device, with usual care which may have been outpatient therapy for walking distance performance following intervention (median difference 418m, IQR 165 vs 389m, IQR 188; p=0.168) and at 6 months follow up (median difference 425m, IQR 121 vs 382m, IQR 219; 0.208).

Toh et al (2022) *[475]* including 26 studies (n = 1,428) compared the effects of home-based upper limb rehabilitation for hemiparetic upper limb recovery to conventional therapy. Meta-analysis of 9 studies (n= 583) showed that home-based intervention was more effective in improving upper limb function (SMD 0.28, 95% CI 0.12 to 0.44) than the control. Subgroup analysis of 4 studies (n = 89) reported that among home-based interventions, electrical stimulation provided significant improvement in limb function (SMD 0.64, 95% CI 0.21 to 1.07) compared to sham or task-specific training interventions.

Qin et al (2022) *[476]* including 49 studies (n = 7,201) on the effectiveness of home-based interventions in improving activities of daily living in stroke patients compared to institution-based usual care finding no significant differences between groups. Meta-analysis was limited to 2-4 studies due to high heterogeneity between studies. Home-based intervention in combination with usual care showed a significant short-term effect on activities of daily living (SMD 0.55, 95% CI 0.22 to 0.87; 2 studies, n=152), compared with usual care alone.

Nascimento et al (2022) *[478]* including nine studies (n = 609) comparing home-based exercises to centre-based exercises measuring walking speed, balance, mobility and participation outcomes. Home-based and centre-based interventions provide similar effects on walking speed (MD -0.03 m/s, 95% CI -0.07 to 0.02) and balance (MD 0 points, 95% CI -1 to 2).

Mobility (SMD -0.4, 95% CI -1.3 to 0.4) and participation (MD -5 points, 95% CI -19 to 10) were imprecise. The effects of home-based and centre-based exercises are likely to be similar improvements after stroke and remained similar beyond intervention period for walking speed (MD 0.02 m/s, 95% CI −0.02 to 0.07) and balance (MD 0 points, 95% CI -1 to 2). A negligible effect on mobility beyond intervention favoured centre-based (MD -1 point, 95% CI -2 to 0) and no trials compared the long-term effects on participation.

Outcome Timeframe	**Study results and measurements**	**Comparator** Community-based rehabilitation (therapist in person)	**Intervention** Home-based rehabilitation (therapist in person)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Short-term activities of daily living 6-8 weeks 8 Critical	Measured by: Barthel index High better Based on data from 245 participants in 2 studies. (Randomized controlled) Follow up: 6-8 weeks.	Difference:	**MD 1 higher** (CI 95% 0.12 higher — 1.88 higher)	**Low** Due to serious imprecision, Due to serious risk of bias [1]	Home-based rehabilitation may have little or no difference on short-term ADL.
Medium-term activities of daily living 6 months 8 Critical	Measured by: Barthel Index High better Based on data from 912 participants in 6 studies. (Randomized controlled) Follow up: 6 months.	Difference:	**MD 0.65 higher** (CI 95% 0.5 lower — 1.81 higher)	**Low** Due to very serious inconsistency [2]	Home-based rehabilitation may have little or no difference on medium-term ADL.
Quality of Life 90 days post stroke 9 Critical	Measured by: Euro-Qol-5D High better Based on data from 61 participants in 1 studies. (Randomized controlled) Follow up: 90 days.	0.66 points (Median)	0.77 points (Median)	**Low** Due to serious risk of bias, Due to serious imprecision [3]	Home-based rehabilitation may improve quality of life
Disability 90 days 9 Critical	Measured by: mRS Scale: 0 — 6 Lower better Based on data from 61 participants in 1 studies. (Randomized controlled) Follow up: 90 days.	3 (Median)	2 (Median) CI 95%	**Low** Due to serious risk of bias, Due to serious imprecision [4]	Home-based rehabilitation may improve disability

1. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
2. **Inconsistency: very serious.** The magnitude of statistical heterogeneity was high, with I^2:80%., The confidence interval of some of the studies do not overlap with those of most included studies/ the point estimate of some of the included studies.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias.. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
4. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Community-dwelling adults with stroke
Intervention: Home-based rehabilitation
Comparator: Centre-based rehabilitation

Summary

Hillier et al (2010) *[53]* compared outcomes from home-based and centre-based rehabilitation for people living in the community following stroke in a systematic review and meta-analysis. Centre-based rehabilitation was delivered in settings such as outpatient clinics or day hospitals. Eleven randomised controlled trials were included, with most reporting Barthel Index scores as a measure of activities of daily living (ADL). Meta-analysis showed significantly increased Barthel Index scores at 3 months for home-based rehabilitation (MD 1 point, 95% CI 0.12 to 1.88), with non-significant differences at 6 months. A subsequent randomised trial by Rasmussen et al (2016) *[51]* assessed quality of life and disability outcomes among patients (N = 71) randomly assigned to home-based or standard care. The trial commenced during hospitalisation. Standard care included inpatient rehabilitation with therapy provided by the multidisclinary team 5 days a week. Intervention participants received in-home rehabilitation 1 to 3 days a week during hospitlisation, and 1 to 5 days a week post-discharge. Details about standard care after discharge was not provided. Quality of life, assessed using EuroQol-5D, was significantly improved in the home-based rehabilitation group (Intervention median = 0.77, IQR = 0.66–0.79; Control median = 0.66, IQR = 0.56 – 0.72; P=0.03), as was disability measured using the modified Rankin scale (Intervention median = 2, IQR = 2-3; Control median = 3, IQR = 2–4; P=0.04).

A systematic review by Doig et al (2010) *[52]* included trials comparing home-based and hospital-based rehabilitation for patients with acquired brain injury, including 17 studies, 15 of which included stroke patients. Meta-analysis was not performed, but the review found that home-based rehabilitation appeared to be at least equivalent to hospital-based care in improving impairment and activity limitations.

A review by Chi et al (2019)*[66]* explored home-based rehabilitation with 49 studies and 4597 participants. Fourty five of the studies were only home visits and four studies combined home visits and phone interviews. Thirty two studies provided only ADL training, five studies combined ADL training, physiotherapy and occupational therapy, seven studies described the intervention as only rehabilitation and two studies had exercise as the intervention program. Regarding types of controls, eighteen studies had an activity control (outpatient/hospital rehabilitation) and thirty one studies used an inactive control (usual care, education, no treatment). Home-based rehabilitation significantly improved physical function (weighted average ES 0.80, 95% CI 0.62 to 0.98; 49 studies, n= 4597) and was sustained in sensitivity analysis where studies with large effect size (≥2) were removed (g 0.58, 95% CI 0.45 to 0.70; 43 studies, n= 4071). Studies that had an inactive control group had greater effects on physical function than an active control group (g= 0.98 vs 0.51, p=0.005).

A study by Chen et al (2017)*[65]* explored the effects of home-based telesupervised rehabilitation for survivors of stroke with hemiplegia (n= 51). Both groups received physical exercises and electromyography-triggered neuromuscular stimulation, one group from the home setting and one group from the hospital outpatient rehabilitation setting. No significant difference was found for ADL between the two groups at the 2 timepoints (12 weeks: MD 2.08, 95% CI -5.17 to 9.34; 24 weeks: MD 1.52, 95% CI -5.01 to 8.05). The carer stress index score declined in both groups over time, but no significant difference was found between groups at 12 weeks (MD 41, 95% CI -0.66 to 1.49) and 24 weeks (MD 0.43, 95% CI -0.62 to 1.49).

A study by Nordin et al (2019)*[69]* comparing home-based career-assisted therapy to hospital-based therapist delivered therapy (n= 91) and observed significant improvement for both groups in mobility (p< 0.01), gait speed (p< 0.01) and quality of life score (p< 0.03) at the end of intervention. No statistical differences were found between the groups for any of the outcomes (all p> 0.05).

A randomised crossover trial by Hsieh et al (2018)*[70]* (n= 26) observed significantly greater improvements from pre- to post- treatment in Motor Activity Log (p=0.01) and sit-to-stand test (p= 0.03) for home-based rehabilitation than clinic-based rehabilitation. However, clinic-based rehabilitation had better quality of life (p= 0.02) than the home-based rehabilitation group.

Bok et al (2023) *[477]* reviewed 10 studies (n = 761) evaluating the effect size of different applied technology in home-based rehabiliation. Virtual reality (VR) intervention showed the largest effect size (0.850; 95% CI: 0.314 to 1.385), followed by robot-assisted interventions (0.129; 95% CI: 0.025 to 0.232). The effect size in game intervention was insignificant (-0.162; 95% CI: -0.534 to 0.210). Heterogeneities in VR and game intervention studies were high (I2 = 77.5% and I2 = 77.4% respectively).

Outcome Timeframe	**Study results and measurements**	**Comparator** Centre-based rehabilitation	**Intervention** Home-based rehabilitation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Activities of daily living 6-8 week post intervention 8 Critical	Measured by: Barthel index High better Based on data from 245 participants in 2 studies. (Randomized controlled)	Difference:	**MD 1 higher** (CI 95% 0.12 lower — 1.88 higher)	**Low** Due to serious indirectness, Due to serious imprecision [1]	Home-based rehabilitation may improve ADL.
Activities of daily living 6 months post-intervention 8 Critical	Measured by: Barthel index High better Based on data from 912 participants in 6 studies. (Randomized controlled)	Difference:	**MD 0.65 higher** (CI 95% 0.5 lower — 1.81 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [2]	Home-based rehabilitation may improve ADL.

1. **Risk of Bias: no serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: serious.** Differences between the population of interest and those studied. **Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
2. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Goal setting

Goal setting helps direct rehabilitation efforts throughout the various stages of recovery (Rosewilliam et al. 2015 *[73]*). Goal setting for patients should take into consideration that the needs of each individual will vary depending on the type of stroke, symptoms and the individual's cultural and psycho-social circumstances. Therefore, a 'patient' or 'person-centred' approach is required which establishes rehabilitation goals that are relevant to an individual's needs (Rosewilliam et al. 2015 *[73]*). The National Stroke Audit revealed 15% of acute stroke patients and 8% of patients in inpatient rehabilitation did not have documented evidence that goals were set jointly with the interdisciplinary team and patient (Stroke Foundation 2019 *[7]*; Stroke Foundation 2020 *[8]*). Goals developed in team meetings should be documented and agreed to by the stroke survivor and/or family/carer. Outcome measures based on goal attainment scales can be considered by the interdisciplinary team to improve the use of goal setting.

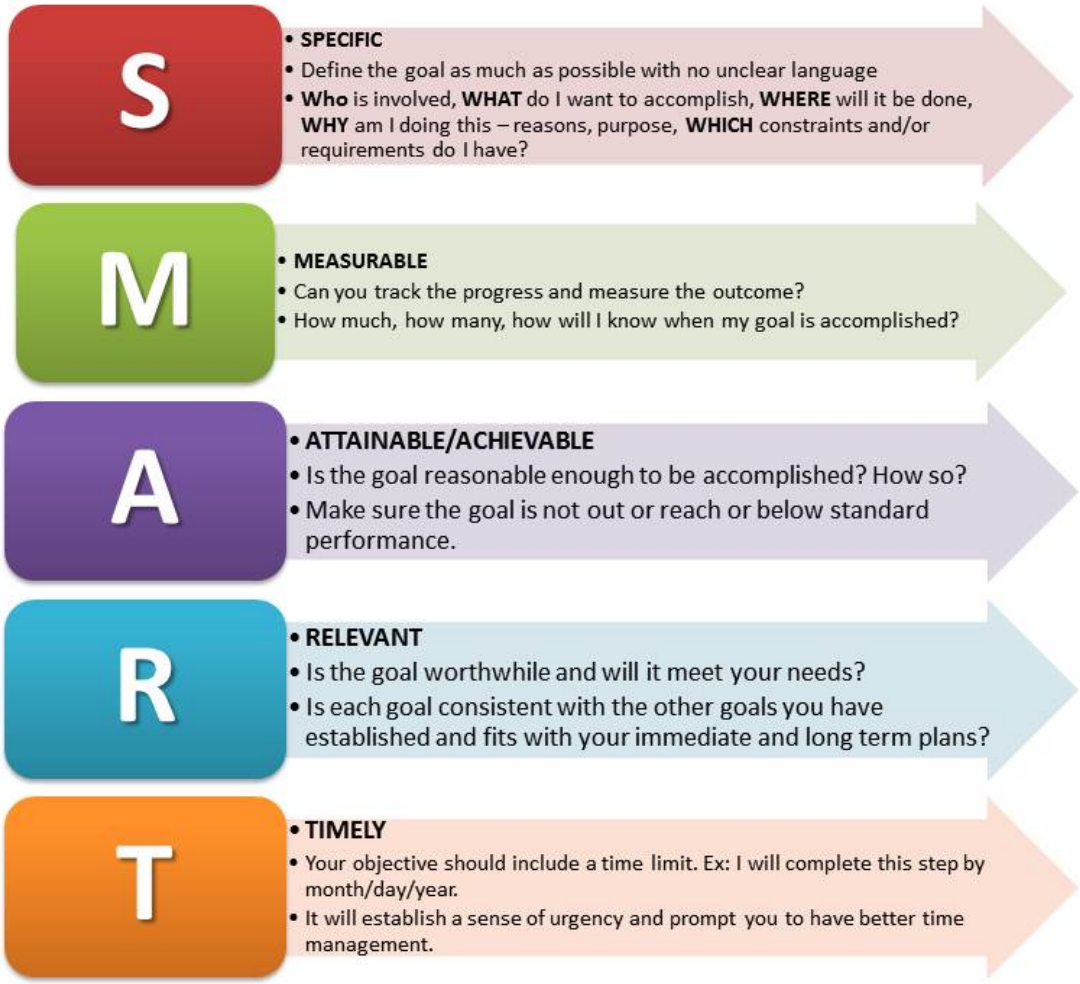
Strong recommendation

- Health professionals should initiate the process of setting goals, and involve stroke survivors and their families and carers throughout the process. Goals for recovery should be client-centred, clearly communicated and documented so that both the stroke survivor (and their families/carers) and other members of the rehabilitation team are aware of goals set. (Sugavanam et al. 2013 *[71]*; Taylor et al. 2012 *[72]*)
- Goals should be set in collaboration with the stroke survivor and their family/carer (unless they choose not to participate) and should be well-defined, specific and challenging. They should be reviewed and updated regularly. (Sugavanam et al. 2013 *[71]*; Taylor et al. 2012 *[72]*)

Practical Info

The SMART principles are a useful tool for goal setting:
Goal setting is facilitated by:

1. Tailoring the process to individual patient's needs and preferences
2. Using structured processes, tools and resources
3. Early, effective and frequent communication between staff and patients.



The EnableMe website can be used to enter patient goals which can be monitored and updated over time.

Be aware that some patients may not be ready to identify goals immediately after a stroke as they are still trying to process the stroke. It is important that once goals are identified, they are discussed with everyone involved with the patient, and are reviewed regularly. A patient's goals sometimes change along the way, and so it is important to be flexible.

Setting timeframes do not work for everyone - sometimes if a patient does not achieve a goal in a set timeframe it can have a negative effect on their rehabilitation. Consider, instead, providing positive encouragement, and a timeline of improvement from the 'stroke event' to 'now'.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

A systematic review (Sugavanam et al. 2013 *[71]*) reports favourable effects of goal setting, although these have not been demonstrated in randomised controlled trials to date. No harms have been identified.

Certainty of the Evidence

Low

There is a lack of high quality trials and thus the evidence is low.

Values and preferences

No substantial variability expected

Individual preferences and cultural background may influence involvement of the stroke survivor and their family in goal setting.

Resources and other considerations

No important issues with the recommended alternative

Resources considerations

There is limited evidence that goal setting interventions post stroke may be cost-effective. An extended stroke rehabilitation service provided in the United Kingdom comprised five structured reviews of goals over 18 months post discharge wherein rehabilitation goals were set by patients and an action plan then made by a multidisciplinary team (Rodgers et al 2019*[75]*). In this randomised control trial (Intervention n=285; Control n=288), data on patient-level resource utilisation were obtained from self-reported questionnaires and converted into costs (reference year 2017). From the health and social care perspective, at 24 months post randomisation, the intervention was found to be less costly and more effective (incremental cost saving of £311 (95% CI: −£3292 to £2787); with an incremental QALY gained of 0.07 (95% CI: 0.01 to 0.12 QALYs) per person compared to usual care.

In a randomised controlled trial from Japan (Intervention n=24; Control n=24) shared decision making toward goal setting for occupation-based activities, incorporating an iPad-based application, was found to be cost-effective when compared to usual impairment-based occupational therapy (Nagayama et al 2017*[76]*). The patients were recruited from a sub-acute ward and the costs reported from a healthcare perspective. Individuals in both groups were provided occupational-therapy for over 40 minutes, more than five times per week and they received physical and speech therapy prior to discharge. However, participants in the intervention group were asked to set occupation-based goals and prioritized the occupations which were most useful to them. Only direct medical costs accrued during hospitalisation (for example hospitalisation, rehabilitation, radiographic examinations, occupational therapist), obtained from patients' receipts, were included in this economic analysis. These authors found that the intervention was associated with greater QALY gains, but no statistically significant differences in costs between the intervention and control groups were found after adjustment for confounding factors.

Implementation considerations

Stroke survivors can use the EnableMe website to enter goals which can be monitored and updated over time. There is a clinical indicator collected in the National Stroke Audit on whether rehabilitation goals were set with input from both the interdisciplinary team and the patient, if the patient had no cognitive or communication difficulties. If the patient had identified cognitive or communication difficulties, a clinical indicator is collected on whether the patient's family or carer(s) had input in the goal setting process. There are also organisational indicators collected to determine whether a formal process is in place at the hospital for goal setting and, if there is, through what means patient-directed goals are usually established.

Rationale

The process of setting goals is a key component of person-centred care and has a number of functions, including directing treatment, motivating the patient and starting a dialogue between the health professional and stroke survivor and their families/ carers about the expected level of recovery. There is a lack of evidence from randomised controlled trials regarding the benefits of goal setting on stroke patient outcomes, but in general the literature suggests that goal setting is positively regarded by clients and health professionals. There is clear consensus, both within the Content Working Parties and in published literature, that goal setting is beneficial for the rehabilitation process and should always take place with the stroke survivor and family/carer (Playford et al. 2009 *[74]*). In the absence of information about the most effective method of goal setting it is sensible to recommend the simple and widely used SMART process of setting specific and challenging goals which are reviewed regularly (see Practical info section for further information about SMART).

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Patient centred goal setting
Comparator: Usual care

Summary

A cluster randomised trial in New Zealand reported by Taylor et al (2012) *[72]* was small (N = 41) and evaluated an intervention centred around the Canadian Occupational Performance Measure. The intervention emphasised person-centred goal setting and feedback and communication. As a feasibility study, the trial was not powered to detect between-group differences.

Systematic reviews have failed to identify high-quality studies. A systematic review by Rosewilliam et al (2011) *[73]* identified eighteen qualitative and eight quantitative and one mixed method study conducted in stroke rehabilitation

services ranging from acute to community rehabilitation. The authors concluded that effects of following patient-centred goal-setting practice have been studied mostly with weak methodologies, but the studies showed some benefit with psychological outcomes. A later systematic review by Sugavanam et al (2013) *[71]* included 17 observational studies, but failed to identify any randomised trials. The authors reported that four observational studies found improved performance and satisfaction at discharge and that two studies reported perceived improvements in self-care skills and better ability to recall treatment goals and manage more tasks.

Fishman et al (2021)*[77]* found goal setting delivered in conjunction with a cognitive training program in patients more than 3 months post stroke improved executive function and memory compared to undertaking the cognitive training alone. This intervention was delivered in a single session in 72 participants and further studies are needed to confirm these results.

Given the lack of high-quality evidence, it is uncertain whether goal setting is associated with improved quality of life, activities of daily living function, length of stay or self-efficacy.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Patient centred goal setting	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Quality of life 12 weeks post admission 7 Critical	Measured by: SEIQOL-DW Scale: 0 — 100 High better Based on data from 41 participants in 1 studies. (Randomized controlled) Follow up: 12 weeks.	Difference:	**MD 3.1 higher** (CI 95% 40 lower — 46.2 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [1]	It is uncertain whether goal setting leads to improved quality of life.
ADL function [2] 12 weeks post admission 7 Critical	Measured by: Functional Independence Measure Scale: 18 — 126 High better Based on data from 41 participants in 1 studies. (Randomized controlled) Follow up: 12 weeks.	Difference:	**MD 0.9 higher** (CI 95% 9.1 lower — 10.8 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [3]	The systematic review (Sugavanam et al) reported that all four studies reported improved 'performance and 'satisfaction' at discharge implying recovery.
Length of stay at time of discharge 7 Critical	Measured by: Days Lower better Based on data from 41 participants in 1 studies. (Randomized controlled) Follow up: at discharge.	26.8 (Mean)	51.7 (Mean) CI 95%	**Low** Due to serious risk of bias, Due to serious imprecision [4]	It is uncertain whether goal setting leads to a difference in length of stay.
Self efficacy Not specified 7 Critical	Based on data from 142 participants in 2 studies. (Observational (non-randomized)) Follow up: Not reported.	A systematic review (Sugavanam et al) reported that two studies measured 'perceived ability and engagement in rehabilitation'. One quasi experimental study found improved perceived self care ability following intervention. Another study found that those participating in goal setting could recall their treatment goals better and 'manage more tasks'		**Very low** Due to very serious risk of bias, Due to serious inconsistency, Due to serious indirectness, Due to serious imprecision [5]	It is uncertain whether goal setting leads to improved self efficacy; two studies suggest improved perception of performance and improved recall of treatment goals.

1. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Selective outcome reporting. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Based on 1 study with 41 participants. **Publication bias: no serious.**
2. Measured using FIM (Functional Independence Measure)
3. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection

bias, Selective outcome reporting. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
4. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Selective outcome reporting. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
5. **Risk of Bias: very serious.** No randomised trials. **Inconsistency: no serious. Indirectness: serious.** Differences between the outcomes of interest and those reported (e.g short-term/surrogate,not patient-important). **Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Sensorimotor impairments

Weakness, loss of sensation and vision are discussed separately below.

Weakness

Weakness is the most common impairment after stroke. Traditionally, strength training and task-oriented training have been used to improve weakness. In recent years, the effect of different types of training have been investigated including repetitive practice (De Sousa et al 2018 *[82]*) and progressive resistance training (Dorsch et al 2018 *[83]*). Repetitive practice is defined as repeated voluntary contraction of affected upper or lower limb muscles. Practice can include a whole task (such as standing up and walking, or components of a task such as elbow extension/flexion. Repetitive task training can be provided using different therapy modalities including electrotherapy such as FES robotics and virtual reality. Progressive resistance training according to the American College of Sports Medicine is defined as resistance training using a load of 8-12 repetition at maximum for at least two sets and these loads need to increase progressively.

Electrical stimulation may have the potential to improve strength after stroke by increasing activation of motor units and/or the cross-sectional area of a muscle, even when patients are unable to undertake interventions involving resistance exercises (Nascimento et al. 2014 *[78]*).

Strong recommendation

For stroke survivors with reduced strength in their arms or legs, progressive resistance training should be provided to improve strength. (Dorsch et al. 2018 *[83]*)

Practical Info

In many studies and in clinical settings, strengthening interventions are not progressive resistance training (PRT) as defined by the American College of Sports Medicine, which states that training should use a load of 8-12 repetitions maximum (i.e. the highest load that can be moved no more than 8-12 times before muscle fatigue) for at least two sets and these loads need to increase progressively. In this review of PRT, the majority of studies targeted leg strength including the following muscle groups: hip extensors and flexors in four studies, hip abductors in one trial, knee extensors in nine studies, knee flexors in six studies and ankle dorsiflexors and plantar flexors in six studies.

In two studies arm strength was targeted, focussing on shoulder flexors and extensors and elbow flexors and extensors in two studies and shoulder external and internal rotators, shoulder abductors and adductors, wrist flexors and extensors and hand muscles in one study.

The load ranged between 7 and 15 repetition maximum (RM) or between 50-80% of 1 RM. The number of sets ranged from 2-4, frequency of training from 2-4 days a week and duration from 4 -12 weeks.

As PRT is applied using high external resistance to movement, participants need to have sufficient strength to do this type of training, i.e. greater than anti-gravity strength. Some stroke survivors will not have sufficient initial strength to participate in this type of training and will need to use other strengthening interventions.

The person with stroke should be given simple, clear pictorial instructions including the use of any equipment or safety issues if repetitions are required outside of therapy. Progress could be charted to to help motivation but post-stroke fatigue or pain should be monitored.

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

There is strong evidence that progressive resistance training (PRT) improves strength after stroke, however, it is unclear if PRT is effective in improving arm or leg activity. (Dorsch et al 2018 *[83]*) There is no evidence of harm.

Certainty of the Evidence

Moderate

Evidence quality is moderate due to risk of bias and/or degree of statistical heterogeneity.

Values and preferences

No substantial variability expected

No substantial variability expected in preferences and values of people with stroke.

Resources and other considerations

No important issues with the recommended alternative

Little or no additional resources are required to implement PRT, however, therapists need to ensure this is part of active stroke rehabilitation where appropriate.

Rationale

Dorsch et al (2018)*[83]* reported a systemic review on progressive strength resistance (PRT) training that included six trials (163 participants). PRT was defined using the American College of Sports Medicine definition, which states that training should include a load of 8-12 repetition maximum for at least two sets and these loads need to increase progressively. The results show that PRT had a large effect (SMD 0.98, 95% CI 0.67 to 1.29) on improving strength compared to no intervention or placebo and should therefore be undertaken by people with weakness post stroke.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Progressive resistance training
Comparator: Control

Summary

A systematic review by Dorsch et al (2018)*[83]* investigated the effectiveness of progressive strength resistance (PRT) training which was defined using the American College of Sports Medicine definition. Eleven trials (N=314 participants) were included, six (N=163) of which were pooled to report strength and activity outcomes. The main outcome was muscle strength measured as maximum force/torque and congruent with the muscles trained, measured immediately after the intervention. Secondary outcome was activity. The results show that PRT has a large effect on improving strength compared to no intervention or placebo (SMD 0.98 (95% CI 0.67 to 1.29) but the effect on activity was unclear (SMD 0.42, 95% CI −0.08 to 0.91, I^2 = 54%).

Previous systematic review of upper-limb strength training included 13 randomised controlled trials with 517 total participants (Harris et al 2010*[80]*). Strength training significantly improved upper limb function (SMD 0.21) and grip strength (SMD 0.95), but did not significantly improve ADL. There was large variation in the types of interventions used in the trials and the outcome measurements, creating some uncertainty about the degree of benefit expected following any particular treatment method.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Progressive resistance training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Strength [1] End of treatment (mean 9 weeks) 9 Critical	Measured by: Maximum force or torque High better Based on data from 163 participants in 6 studies. [2] (Randomized controlled)	Difference:	**SMD 0.98 higher** (CI 95% 0.67 higher — 1.29 higher)	**Moderate** Due to serious risk of bias [3]	Progressive resistance training improves strength

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Progressive resistance training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Functional activity [4] End of treatment (mean 9 weeks) 8 Critical	Follow up: Mean 9 weeks of treatment. Measured by: Various High better Based on data from 163 participants in 6 studies. [5] (Randomized controlled) Follow up: Mean 9 weeks of treatment.	Difference:	**SMD 0.42 higher** (CI 95% 0.08 lower — 0.91 higher)	**Moderate** Due to risk of bias, Due to serious inconsistency [6]	Progressive resistance training may improve activity

1. Measures of strength were maximum force (six studies) or torque (five studies). Four studies measured force or torque isometrically, while seven studies measured it dynamically (isokinetically or isotonically).
2. Systematic review [83] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious.** The majority of studies randomly allocated participants (100%), had similar groups at baseline (91%), had blinded assessors (73%), reported < 15% dropouts (91%), reported between-group differences (100%), and reported point estimate and variability (100%). The majority of studies did not report that they concealed allocation (55%) or carried out an intention-to-treat analysis (64%). All studies did not blind therapists and participants, which is not possible for this intervention.. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
4. Of the nine lower limb studies, seven measured activity as walking speed, one as the Timed Up and Go test, and one as the lower limb part of the Fugl-Meyer Assessment. Of the two upper limb studies, one measured activity as the Wolf Motor Function Test and one as the Functional Test of Hemiparetic Upper Extremity.
5. Systematic review [83] . **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: serious.** The majority of studies randomly allocated participants (100%), had similar groups at baseline (91%), had blinded assessors (73%), reported < 15% dropouts (91%), reported between-group differences (100%), and reported point estimate and variability (100%). The majority of studies did not report that they concealed allocation (55%) or carried out an intention-to-treat analysis (64%). All studies did not blind therapists and participants, which is not possible for this intervention.. **Inconsistency: no serious.** The magnitude of statistical heterogeneity was moderate, with I^2:54%.. **Indirectness: no serious. Imprecision: no serious.** Wide confidence intervals. **Publication bias: no serious.**

Attached Images

Weak recommendation

- For stroke survivors with arm weakness, repetitive practice using assistive technology, constraint induced movement therapy (CIMT), and robotics may be used to improve arm strength. (de Sousa et al 2018 *[82]*)
- For stroke survivors with leg weakness, task specific training, repetitive practice using cycling, or electrical stimulation may be used to improve leg strength. (de Sousa et al 2018 *[82]*)

Practical Info

Repetitive practice was provided using different types of interventions including: CIMT, cycling, FES (with or without active movement), mirror therapy, robotics/assistive technology, task specific training, whole body vibration (with active movement), Bobath, mixed therapies, video games and water-based exercises. For stroke survivors with arm weakness repetitive practice using CIMT, and robotics/assistive technology, appeared to be most useful for improving arm strength (de Sousa et al 2018 *[82]*). For stroke survivors with leg weakness task specific training, repetitive practice using cycling, or FES appeared to be most useful for improving leg strength (de Sousa et al 2018).

The duration of therapy sessions ranged from 15 to 360 minutes. The overall dose, ranged from 2.2 hours over 4 weeks to 60 hours over 2 weeks. The number of repetitions participants completed ranged from 5 to 1800 repetitions per exercise.

The person with stroke should be given simple, clear pictorial instructions including the use of any equipment or safety issues if repetitions are required outside of therapy. Progress could be charted to to help motivation but post-stroke fatigue should be monitored.

Evidence To Decision

Benefits and harms — Substantial net benefits of the recommended alternative

There is evidence that repetitive practice improves strength and activity levels of the arm and leg (de Sousa et al 2018 *[82]*). There is no evidence of harm.

Certainty of the Evidence — Moderate

Evidence quality is moderate overall due to risk of bias but certainty for specific types of intervetions ranged from very low to moderate.

Values and preferences — No substantial variability expected

No substantial variability expected in the preferences and values of people with stroke.

Resources and other considerations — No important issues with the recommended alternative

Repetitive practice is already part of routine therapy. There are no important issues or additional resources required when providing this intervention.

Rationale

A large systematic review (46 studies, n=1928 participants) found modest improvements in strength with repetitive practice. Some specific interventions were found to be beneficial while others are unclear. Improvements in strength were found to positively impact on arm and leg activity (see various topics in Activity Limitations section and also French et al 2016 *[232]*).

Clinical Question/ PICO

Population: Adults with stroke with weakness
Intervention: Repetitive practice
Comparator: Control

Summary

de Sousa et al (2018)*[82]* conducted a review on the effect of repetitive practice. Different types of therapies were included and results for each therapy were reported separately. Additionally, results for arm and leg strength were reported separately. Overall repetitive training combining 46 studies (n=1928) for upper and lower limbs was improved strength (SMD 0.25, 95% CI 0.16-0.34). This effect was robust based on sensitivity analysis on various aspects of risks of biases.

For stroke survivors with arm weakness repetitive practice using assistive technology (SMD 1.02 95%CI 0.26 to 1.78; 2 studies, n=32), CIMT (SMD 1.49 95%CI 0.44 to 2.54; 2 studies, n=22), and robotics (SMD 0.52 95%CI 0.10 to 0.94; 2 studies, n=93) may improve arm strength. Overall the effects of repetitive training translated to an absolute mean increase in 3.1/57 points on the ARAT (upper limb activity). For stroke survivors with leg weakness repetitive practice using cycling (SMD 0.49 95%CI 0.10 to 0.88; 2 studies, n=104), FES (SMD 0.45 95%CI 0.07 to 0.84; 3 studies, n=107) and task specific training (SMD 0.27 95%CI 0.09 to 0.44; 8 studies, n=540) appear to improve leg strength. The evidence is strongest for task specific training for leg strength. Overall the effects of repetitive training translated to an

absolute mean increase of 0.13m/s in walking speed.

Pinheiro et al (2020) *[461]* (n= 20) found aerobic cycling training improved lower limb strength (hip flexor, knee extensor and ankle dorsiflexor, p< 0.05), gait speed (10MWT, p< 0.05), balance (BBS, p< 0.05), mobility (ICU mobility scale, p< 0.05) and functionality (Perme Score, p< 0.05).

Hyun et al (2021) *[460]* (n=30) observed improved lower extremity muscle strength (hip flexor F= 6.690, p< 0.015; hip abductor F= 6.930, p, 0.014; knee extensor F= 6.152, p< 0.02), balance ability (COP F= 10.849, p, 0.003; BBS F= 5.403, p<0.028), walking ability (TUG F= 7.207, p< 0.012; 10MWT F= 5.796, p< 0.023) and quality of life (SS-QOL F= 28.050, p, 0.000; 10m walk test F=5.796, p, 0.023) in the real-time visual feedback using a Wii Balance Board sit-to-stand training compared to classic sit-to-stand training.

The effects repetitive practice using Bobath, mixed therapies, mirror therapy, mixed therapies, video-games, whole body vibration and water-based exercises compared to no intervention or sham intervention on strength is unclear based on very low certainty evidence.

There is little evidence on adverse events with repetitive practice.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Repetitive practice	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Strength (lower extremities) Post intervention (2 to 52 weeks of treatment) 9 Critical	Measured by: Various measures High better Based on data from 955 participants in 21 studies. [1] (Randomized controlled) Follow up: 2 - 52 weeks.	Difference:	**SMD 0.34 higher** (CI 95% 0.22 higher — 0.47 higher)	**Moderate** Due to serious risk of bias [2]	Repetitive practice training probably increases strength (lower extremities) although benefits are modest
Strength (upper extremities) Post intervention (2 to 52 weeks of treatment) 9 Critical	Measured by: Various measures High better Based on data from 973 participants in 25 studies. [3] (Randomized controlled) Follow up: 2 - 52 weeks.	Difference:	**SMD 0.16 higher** (CI 95% 0.03 higher — 0.29 higher)	**Moderate** Due to serious risk of bias [4]	Repetitive practice training probably increases strength (upper extremities) although benefits are small
Lower limb activity Post intervention (2 to 52 weeks of treatment) 7 Critical	Measured by: Various measures High better Based on data from 952 participants in 20 studies. [5] (Randomized controlled) Follow up: 2 - 52 weeks.	Difference:	**SMD 0.25 higher** (CI 95% 0.12 higher — 0.38 higher)	**Moderate** Due to serious risk of bias [6]	Repetitive practice training probably increases lower limb activity although benefits are modest
Upper limb activity Post intervention (2 to 52 weeks of treatment) 7 Critical	Measured by: Various measures High better Based on data from 912 participants in 24 studies. [7] (Randomized controlled) Follow up: 2 - 52 weeks.	Difference:	**SMD 0.15 higher** (CI 95% 0.02 higher — 0.29 higher)	**Moderate** Due to serious risk of bias [8]	Repetitive practice training probably increases upper limb activity although benefits are small

1. Systematic review [82] . **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [82],
2. **Risk of Bias: serious.** ROB elements ranged across studies and all studies had high risk due to performance bias (100% studies). Allocation concealment was adequate in 31% of studies and randomisation sequence was adequate in 69%. Lack of blinded outcomes occurred in 29% of studies. . **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. Systematic review [82] . **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [82],
4. **Risk of Bias: serious.** ROB elements ranged across studies and all studies had high risk due to performance bias (100% studies). Allocation concealment was adequate in 31% of studies and randomisation sequence was adequate in 69%. Lack of blinded outcomes occurred in 29% of studies. . **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
5. Systematic review [82] . **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [82],
6. **Risk of Bias: serious.** ROB elements ranged across studies and all studies had high risk due to performance bias (100% studies). Allocation concealment was adequate in 31% of studies and randomisation sequence was adequate in 69%. Lack of blinded outcomes occurred in 29% of studies. . **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

7. Systematic review [82] . **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [82],
8. **Risk of Bias: serious.** ROB elements ranged across studies and all studies had high risk due to performance bias (100% studies). Allocation concealment was adequate in 31% of studies and randomisation sequence was adequate in 69%. Lack of blinded outcomes occurred in 29% of studies. . **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Weak recommendation

For stroke survivors with reduced strength in their arms or legs (particularly for those with less than antigravity strength), electrical stimulation may be used. (de Sousa et al. 2018 *[82]*; Nascimento et al. 2014 *[78]*)

Practical Info

There is currently no consensus as to the optimal dosage of electrical stimulation and further research is needed to establish which groups of patients benefit more (i.e. weak vs very weak), optimal parameters (frequency and pulse width), timing and duration of the intervention.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

There are small to moderate benefits for improvements in strength following electrical stimulation and no evidence of harm (Nascimento et al. 2014 *[78]*; de Sousa et al. 2018 *[82]*).

Certainty of the Evidence

Low

There are important methodological issues with the trials included in the systematic reviews (Nascimento et al. 2014 *[78]*; de Sousa et al. 2018 *[82]*) and our overall certainty in the evidence was rated as low.

Values and preferences

Substantial variability is expected or uncertain

Electrical stimulation is not always tolerated by everyone.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified

Rationale

There are small to moderate benefits for improvements in strength following electrical stimulation and no evidence of harm based on low certainty evidence (Nascimento et al. 2014 *[78]*; de Sousa et al. 2018 *[82]*). There is an indication that there are improvements in strength regardless of whether electrical stimulation is applied with or without voluntary muscle contraction. However, it is difficult to say with certainty which approach (with or without voluntary muscle contraction) is superior.

Electrical stimulation is not always tolerated by everyone, however, the intervention is relatively inexpensive and easy to apply.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Electrical stimulation
Comparator: Control

Summary

Based on a systematic review by Nascimento et al (2014) *[78]*, there is evidence to suggest that electrical stimulation improves strength in people following stroke. However, there is uncertainty in the results of this systematic review for the following reasons:

- Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias (6/11 did not have blinded assessors)
- Inadequate concealment of allocation during randomization process, resulting in potential for selection bias (10/11 did not have concealed allocation)
- Missing intention-to-treat analysis (9/11 trials missing intention-to-treat analysis)

When the trials were grouped according to the initial level of strength, electrical stimulation increased strength in very weak participants (8/11 trials) with an effect size of 0.40 (95% CI 0.17 to 0.65), and in weak participants (3/11 trials) with an effect size of 0.66 (95% CI 0.21 to 1.11). When the trials were grouped according to the time after stroke, electrical stimulation increased the strength in sub-acute participants (6/11 trials) with an effect size of 0.55 (95% CI 0.28 to 0.81), while in chronic participants (5/11 trials) the effect size was 0.33 (95% CI −0.02 to 0.69).

A further systematic review by de Sousa et al (2018) conducted a subgroup analysis of FES. Pooling five studies (n=154) found a small to moderate effect size on strength (SMD 0.43 95%CI 0.10 to 0.75).

Overall the certainty of the evidence is rated as low due to the methodological bias in the included trials.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Electrical stimualtion	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Strength Post intervention 7 Critical	Measured by: Continuous measures of force or torque (9 trials), or ordinal measures such as manual muscle testing (2 trials) High better Based on data from 359 participants in 11 studies. [1] (Randomized controlled) Follow up: 3 - 12 weeks of treatment.	Difference:	**SMD 0.47 higher** (CI 95% 0.26 higher — 0.68 higher)	**Low** Due to serious risk of bias [2]	Electrical stimualtion may improve strength in people following stroke

1. Systematic review [78] . **Baseline/comparator:** Systematic review.
2. **Risk of Bias: serious.** - Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias (6/11 did not have blinded assessors) - Inadequate concealment of allocation during randomization process, resulting in potential for selection bias (10/11 did not have concealed allocation) - 9/11 trials Missing intention-to-treat analysis. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.** The Systematic review used did not search for gray literature.

Attached Images

Loss of sensation

Approximately 38% of stroke patients are assessed as having sensory deficits on admission (Stroke Foundation 2019 *[7]*), with impairments in touch sensation, proprioception and kinaesthesia in most cases (de Diego et al. 2013 *[84]*). Sensation (or somatosensory) deficits can negatively affect motor recovery (Doyle et al. 2010 *[87]*). Moreover, sensation is essential for safety even if there is adequate motor recovery, with secondary complications such as sores, abrasions, and shoulder-hand syndrome being associated with the impairment of sensation (Doyle et al. 2010 *[87]*).

Doyle et al. (2014) *[85]* interviewed stroke survivors and found that sensory impairments significantly impacted stroke survivors' roles and participation but seemed to be ignored in the rehabilitation process. The National Stroke Audit indicated that 101 out of 120 (84%) Australian hospitals had locally agreed assessment protocols for identifying sensory deficits (Stroke Foundation 2019 *[7]*). A survey of Australian occupational therapists and physiotherapists reported that the majority routinely assessed and provided treatments to stroke survivors with sensory loss, but experienced barriers including a lack of access to evidence-based assessments and treatments as well as large workload (Pumpa et al. 2015 *[89]*). Most sensory intervention trials have focussed on the arm and hand. Only one small randomised controlled trial has investigated sensory retraining for the foot and lower limb, with no benefits found (Lynch et al. 2007 *[90]*).

There is a lack of evidence to guide interventions for sensory loss of the lower limb and foot.

Weak recommendation

For stroke survivors with sensory loss of the upper limb, sensory-specific training may be provided. (de Diego et al. 2013 *[84]*; Carey et al. 2011 *[86]*; Doyle et al. 2010 *[87]*)

Practical Info

Sensory discrimination training should be provided as part of a goal directed rehabilitation program. Key components of sensory discrimination training are outlined in Carey et al. (2011) *[86]*, and include graded and progressive discrimination tasks for various textures and object recognition, augmented feedback and self-checking for accuracy as well as intensity of training. A total of ten 60-minute sessions were provided over 3 weeks.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Sensory-specific training, combined with motor function training or by itself, showed small benefits in sensation and activities of daily living (de Diego et al. 2013 *[84]*; Carey et al. 2011 *[86]*; Doyle et al. 2010 *[87]*).

Certainty of the Evidence

Low

Included studies have low quality due to small sample size. Heterogeneity also makes pooling data difficult.

Values and preferences

No substantial variability expected

Stroke survivors with sensation loss report that this greatly impacts on their roles and participation, and they value therapy aimed at improving it (Doyle et al. 2014 *[85]*). Despite only small benefits shown in sensory discrimination training, patients are likely to want to receive it to address sensation loss.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Implementation considerations

There is an organisational indicator collected on whether hospitals have locally agreed protocols in place for patients with

sensory impairment.

Rationale

Several small trials have shown benefits of sensory retraining on improving sensation and possibly activities of daily living after stroke. The most recent trial (Carey et al. 2011 *[86]*) showed benefits from sensory discrimination training compared to non-specific exposure to sensory stimuli. An earlier Cochrane review (Doyle et al. 2010 *[87]*) reported preliminary evidence of the effectiveness of a range of different types of sensation training, including mirror therapy, thermal therapy and pneumatic compression therapy, all from single small studies.

Clinical Question/ PICO

Population: All stroke patients with reduced sensation
Intervention: Sensory-specific training
Comparator: Conventional treatment

Summary

Turville et al (2019)*[94]* included 10 studies (2 RCT, 3 Controlled trials, and 5 single case experimental studies) specifically focused sensory function of the arm (n=199 participants). Sensory specific training was included in 6/10 studies and combined sensory and motor training in 4/10 studies. The pooled effect sizes ranged from 0.3 to 2.2 (average 0.85) across four different sensory modalities. The controlled groups improved but the effects sizes in all but one outcome were lower than the intervention group. The overall quality of evidence is low. The one RCT of high quality (Carey et al (2011)*[86]* compared somatosensory discrimination training and non-specific repeated exposure to stimuli (n = 50). The primary outcome was a composite somatosensory discrimination index, combining scores from the Fabric Matching Test, Wrist Position Sense Test and the function Tactile Object Recognition Test. The intervention group showed significantly greater improvement in somatosensory discrimination immediately following treatment. These improvements appeared to be maintained at 6-week and 6-month follow-ups, but as this was a cross-over trial it was not possible to assess between-group differences at follow-up.

A Cochrane systematic review was conducted by Doyle et al (2010) *[85]* of studies that targeted upper limb sensory impairment after stroke, and were published prior to January 2009. Thirteen studies were identified with 467 participants. No meta-analysis was performed due to a high degree of clinical heterogeneity in both interventions and outcomes. There was some limited preliminary evidence for:

- the effects of mirror therapy for improving detection of light touch, pressure and temperature pain
- a thermal stimulation intervention for improving the rate of recovery of sensation
- intermittent pneumatic compression for improving tactile and kinesthetic sensation

Overall this review did not find sufficient evidence to support or refute the effectiveness of any intervention for improving sensory impairment, upper limb function, or participants' functional status and participation.

Outcome Timeframe	**Study results and measurements**	**Comparator** Conventional treatment	**Intervention** Sensory-specific training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Sensation [1] After 10 sessions of treatment (approx 3 weeks) 7 Critical	Measured by: Improvement from baseline on Standardized Somatosensory Deficit scale High better Based on data from 50 participants in 1 studies. [2] (Randomized controlled)	8 points (Mean) Difference:	19.1 points (Mean) **MD 11.1 higher** (CI 95% 3 higher — 19.2 higher)	Moderate Due to serious imprecision [3]	Sensory-specific treatment probably improves sensation

Outcome Timeframe	**Study results and measurements**	**Comparator** Conventional treatment	**Intervention** Sensory-specific training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Upper limb sensation 7 Critical	Follow up: 10 sessions of treatment, 3 sessions per week. Based on data from 467 participants in 13 studies. (Randomized controlled)	One trial of repetitive thermal stimulation in addition to standard therapy compared to standard therapy alone found beneficial effects in favour of experimental group in rate of recovery of sensation (MD 0.21, 95% CI 0.10 to 0.32), and arm function (Motor Assessment Scale, MD 1.58, 95% CI 0.98 to 2.18) One study of mirror therapy compared to sham intervention found beneficial effects in favour of experimental group in light touch (Quantitative Sensory Test, MD -2.05, 95% CI -2.42 to -1.68). One study of intermittent pneumatic compression compared to sham short-wave therapy found beneficial effects in favour of experimental group in sensation (Nottingham Sensory Assessment, MD 37.10, 95% CI 8.16 to 66.04)		**Low** Due to serious risk of bias, Due to serious imprecision [4]	Sensory-specific training may improve upper limb sensation

1. Composite index of FMT for texture discrimination, WPST for limb position sense, and fTORT for textile object recognition
2. Primary study[86]. **Baseline/comparator:** Control arm of reference used for intervention.
3. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Only data from one study, n=50, but sufficiently powered. **Publication bias: no serious.**
4. **Risk of Bias: serious.** Unclear sequence generation/ generation of comparable groups, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients ranging from 10 to 40 except two with 90 and 100. No mention of power calculations in most trials. . **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: All stroke patients with reduced sensation
Intervention: Sensory-specific training plus motor function training
Comparator: Conventional treatment

Summary

Turville et al (2019)*[94]* included 10 studies (2 RCT, 3 Controlled trials, and 5 single case experimental studies) specifically focused on sensory function of the arm (n=199 participants). Sensory specific training was included in 6/10 studies and combined sensory and motor training in 4/10 studies. Six studies reported arm function (n=89) with a narrative analysis suggesting possible improvements after sensory retraining. The one RCT by de Diego et al (2013) *[84]* compared a sensorimotor stimulation program to standard rehabilitation in a small number of participants (n=21). The intervention was intensive therapy by means of a sensory and motor stimulation:16 sessions of sensory stimulation and functional activity training in the rehabilitation centre, and daily sessions of tactile stimulation, mental imagery and practice of ADL at home for 8 weeks. The control group received standard rehabilitation according to the Bobath concept with 2 sessions per week, without prioritising therapy of the upper limb. The results show that in both

groups, upper limb function and ADL improved during the 8 weeks. The between-group difference was significant for ADL but not upper limb function. Significant improvements were observed for the sensory tests in the intervention group. However, the result for the control group was not reported and thus no comparison can be made.

Yilmazer et al (2019)*[93]* included 8 studies (n = 257) focused on the arm. Active somatosensory interventions did not show a significant effect for light touch (SMD 1.52, 95% CI -0.45 to 3.48; 3 studies, n=87; very low certainty), proprioception (SMD 0.2, 95% CI -0.83 to 1.23; 2 studies, n=58; very low certainty), or higher cortical somatosensation (SMD 0.55, 95% CI -0.01 to 1.12; 1 study, n=50; low certainty). Similarly there was no significant differences found for passive somatosensory interventions for light touch (SMD 0.29, 95% CI -0.43 to 1.01; 3 studies, n=91), proprioception (SMD 0.39, 95% CI, -0.26 to 1.04; 2 studies, n=53) or higher cortical somatosensation (MD 1.17, 95% CI, -1.04 to 3.37; 2 studies, n=61) all based on very low certainty evidence.

Chia et al (2019)*[92]* investigated leg somatosensory function and included 16 studies (n=430). Nine studies were RCT, five were controlled trials and two were other designs. A significant positive summary effect size (SES) was found for somatosensory outcomes (SES 0.52, 95% CI 0.04 to 1.01; moderate heterogeneity I^2 = 74%; 7 studies). Ten studies were rated as weak and six moderate quality.

A systematic review conducted by Serrada et al (2019)*[91]* included 38 studies (n = 1093) and investigated the effect of sensory retraining on sensation and sensorimotor function. Most (29) of the studies involved passive training (external application of stimulation such as electrical stimulation) with six studies involved active sensory discrimination training and three studies involving both. Only two studies (n=61) were pooled based on the Nottingham Sensory Assessment comparing passive approach to sham therapy with no significant difference found (MD 0.59, 95% CI -0.75 to 1.93, high heterogeneity I^2=84%). Meta analyses of 13 of the studies (n = 385), mostly of passive approaches, demostrated a signficiant effect for several arm and leg activity measures (2-3 studies pooled in each measure).

A Cochrane review by Doyle et al (2010) *[85]* included studies that targeted upper limb sensory impairment after stroke and were published prior to January 2009. Thirteen studies were identified with 467 participants. No meta-analysis was performed due to a high degree of clinical heterogeneity in both interventions and outcomes. There was some limited preliminary evidence (based on a single small randomised controlled trials with low risk of bias) for:

- the effects of mirror therapy for improving detection of light touch, pressure and temperature pain
- a thermal stimulation intervention for improving the rate of recovery of sensation
- intermittent pneumatic compression for improving tactile and kinesthetic sensation.

Overall this review did not find sufficient evidence to support or refute the effectiveness if any intervention in improving sensory impairment, upper limb function, or participants' functional status and participation.

Outcome Timeframe	**Study results and measurements**	**Comparator** Conventional treatment	**Intervention** Sensory-specific training plus motor function training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Improvement in ADL After 8 weeks of treatment 8 Critical	Measured by: Improvement from baseline on Stroke Impact Scale - 16 Scale: 16 — 80 High better Based on data from 21 participants in 1 studies. (Randomized controlled) Follow up: 8 weeks.	0.25 (Mean) Difference:	9.83 (Mean) **MD 9.58 higher** CI 95%	**Low** Due to very serious imprecision [1]	Sensory-specific treatment plus motor function training may improve ADL
Improvement in upper limb function After 8 weeks of treatment	Measured by: Improvement from baseline on Fugl Meyer Assessment scale High better Based on data from 21 participants in 1 studies. (Randomized controlled)	3 (Mean) Difference:	5.1 (Mean) **MD 2.1 higher** CI 95%	**Moderate** Due to serious imprecision [2]	Both intervention and control group showed significant improvement from baseline with no significant differences between them.

Outcome Timeframe	**Study results and measurements**	**Comparator** Conventional treatment	**Intervention** Sensory-specific training plus motor function training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
7 Critical	Follow up: 8 weeks.				
Sensation 8 weeks 7 Critical	Based on data from 21 participants in 1 studies. (Randomized controlled) Follow up: 8 weeks.	Sensory discrimination test showed significant improvement in the intervention group. However the result for control group was not reported and no comparison was made.		**Very low** Due to serious indirectness, serious imprecision, and serious risk of bias [3]	We are uncertain whether sensory-specific treatment plus motor function training increases or decreases sensation

1. **Inconsistency: no serious. Indirectness: no serious. Imprecision: very serious.** Low number of patients, Only data from one study; between groups difference was very poorly reported, with no CI. **Publication bias: no serious.**
2. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Only data from one study, Low number of patients. **Publication bias: no serious.**
3. **Risk of Bias: serious.** Selective outcome reporting. **Inconsistency: no serious. Indirectness: serious.** Within-subject comparison - no comparison between intervention and control group. **Imprecision: serious.** Low number of patients, Only data from one study. **Publication bias: no serious.**

Attached Images

Loss of cardiorespiratory fitness

The cardiorespiratory fitness of stroke survivors is low (Marsden et al. 2013 *[100]*; Saunders et al. 2016 *[95]*), with peak oxygen consumption (VO_2 peak) values ranging from 26 to 87% of those of healthy age- and gender-matched individuals (Smith et al. 2012 *[86]*). In the meta-analysis examining cardiorespiratory levels after training undertaken by Saunders et al. *[95]*, baseline levels ranged from to 8 to 24 mL O_2/kg/min. This is an issue as everyday physical activities are often undertaken at light (3.5 to 10.4 mL O_2/kg/min) or moderate intensities (10.5 to 21.0 mL O_2/kg/min) (Norton et al. 2010 *[101]*; ACSM 2010 *[86]*; Ainsworth et al. 2000 *[87]*).

For people with stroke these VO_2 requirements approach or reach their maximum capacities, whereas healthy people can perform activities of daily living comfortably, with fitness reserve to spare. Consequently, low levels of fitness can make undertaking many everyday activities difficult to sustain for any length of time, and more physically demanding activities almost impossible (Ivey et al. 2005 *[103]*). Low levels of cardiorespiratory fitness can increase the risk of recurrent stroke and other cardiometabolic diseases (Billinger et al. 2014 *[99]*).

Improving the cardiorespiratory fitness of stroke survivors has the potential to enhance their ability to undertake activities of daily living and reduce the risk of subsequent events. With improved fitness, the percentage of VO_2 peak required to undertake a task is reduced. This can increase submaximal exercise tolerance and endurance (Billinger et al 2014 *[99]*). Even modest amounts of aerobic training can improve cardiorespiratory fitness by 10 to 15% (Marsden et al. 2013 *[100]*).

After stroke, the regaining of physical function to support independent living is often prioritised in therapy, with little or no focus on training cardiorespiratory fitness. Clinicians may have limited knowledge and experience in prescribing fitness programs for the diverse stroke population they manage (Gordon et al 2004 *[90]*). Inpatient therapy sessions are often below the intensity and duration recommended for providing a cardiovascular challenge (Polese et al. 2014 *[104]*; Kuys et al. 2006 *[106]*; Mackay-Lyons et al. 2002 *[107]*).

Strong recommendation

For stroke survivors, rehabilitation should include individually-tailored exercise interventions to improve cardiorespiratory fitness. (Saunders et al. 2020 *[95]*)

Practical Info

All people after stroke should undergo a pre-exercise evaluation to minimise the potential for adverse events before commencing on a physical activity program (Billinger et al. 2014 *[99]*). This includes a medical and physical examination to identify comorbities or neurological complications that may be a precaution or contraindication to exercise (Billinger et al. 2014 *[99]*). Relative and absolute contraindications to exercise including for people after stroke have been outlined (American College of Sports Medicine 2018 *[115]*; Mead & van Wijck 2013 *[91]*). A graded exercise test with ECG monitoring may be included as part of the pre-exercise evaluation (Billinger et al. 2014 *[99]*).

Once the person is medically stable and has passed a screen for inclusion in cardiorespiratory fitness training an individually tailored program can be prescribed. Billinger et al. (2014) *[99]* recommend aerobic programs should typically include:

- Mode – large-muscle activities such as walking; arm, leg or arm-leg ergometry; functional activities
- Frequency – 3–5 days/week
- Duration – 20–60 min/session (or multiple 10-min sessions) with an additional 5–10 min of warm-up and cool-down activities
- Intensity – 40–70% VO_2 reserve or HR reserve; 55–80% HR_{max}; RPE 11–14 (6–20 scale).

To individually tailor cardiorespiratory fitness training for people after stroke, including those with severe disability, the person's stage of recovery, exercise tolerance, environment, available social support, physical activity preferences, and their specific impairments, activity limitations, and participation restrictions need to be considered (Billinger et al. 2014 *[99]*).

Barriers and enablers to undertaking exercise post-stroke and post-discharge should be addressed with the stroke survivor and carer. Barriers may include lack of motivation, environmental factors such as transport, health concerns, and stroke impairments (Nicholson et al. 2013 *[98]*).

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

Cardiorespiratory fitness training can improve cardiorespiratory fitness and walking ability (speed and capacity), and reduce disability (Saunders et al. 2020 *[95]*). Very few adverse events occur in cardiorespiratory fitness training studies (Saunders et al. 2020 *[95]*).

Certainty of the Evidence

Moderate

There is moderate to high-quality evidence across the main outcomes. There is low certainty for quality of life and too few deaths to be certain about effect on mortality (Saunders et al. 2020 *[95]*).

Values and preferences

No substantial variability expected

No substantial different in preferences is expected. Cardiorespiratory training may enhance social support and the ability to perform daily tasks but will require motivation (Nicholson et al. 2013 *[98]*).

Resources and other considerations

No important issues with the recommended alternative

Resources considerations

Physical fitness training may improve the quality of life of stroke survivors for an acceptable additional cost (Collins et al 2018*[108]*). In a randomised control trial conducted in the United Kingdom (n=66), a decision tree model was used to estimate the cost-effectiveness of a fitness program for stroke survivors compared to relaxation (control group). The programs were delivered by an exercise professional for 1 hour, 3 times a week for 12 weeks to groups of up to 7 survivors

of stroke. Only costs related to delivering the program were included in the analysis. QALYs gained were estimated from data collected from participants in the trial. Several scenarios for the delivery of the intervention were modelled, for example comparing the physical fitness group to the relaxation group, physical fitness group to usual care, physical fitness once a week for up to 12 months, and lastly less than 7 attendees per class). At 7 months follow up, the physical fitness group compared to the relaxation group was found to be most cost effective, costing an additional £2,343 per QALY gained (Incremental cost £80, incremental QALYs gained 0.03, reference year for costs 2014).

Implementation considerations
There are no clinical indicators collected in the National Stroke Audit on fitness training, however, sites are asked about routine fitness training in the organisation survey.

Rationale

Cardiorespiratory fitness training after stroke can improve level of disability, walking speed and endurance and capacity of cardiorespiratory fitness during or immediately after training.

The most effective time to commence cardiorespiratory training is unclear. However given people after stroke have low levels of cardiorespiratory fitness (Marsden et al. 2013 *[100]*) and are very sedentary (English et al. 2014 *[102]*), commencing training while an inpatient can promote 'being active' as part of adopting a healthy lifestyle, which is important for secondary prevention of stroke.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Cardiorespiratory training
Comparator: Control

Summary

A Cochrane review by Saunders et al (2020) *[95]* included 75 trials of fitness training interventions with a total of n=3017 people with stroke, most of whom were able to walk (32 studies, n=1631 for cardiorespiratory training; 20 studies, n=779 for resistance training; 23 studies, n=1207 for mixed training). To date, there have been very few studies that have measured outcomes after the end of the intervention period, meaning that the sustained benefits of fitness training is unknown. There have been too few deaths reported to assess the impact on fitness training on mortality. Participants receiving cardiovascular fitness training had improved fitness, walking endurance and ability to perform ADLs based on moderate-certainty evidence. It is unclear what the impact on QOL is. The duration of interventions varied between four weeks and six months.. Nine out of the 10 studies reported exercise intensity as 60% to 80% heart rate reserve, 50% to 85% maximum heart rate, or 30% to 50% maximum effort; rate of perceived exertion was reported as 13 to 15 in two of 10 studies.

While most trials included in the Cochrane reivew included only stroke survivors who were able to walk, a meta-analysis by Lloyd et al (2018)*[111]* specifically looked at stroke survivors who were non-ambulatory (33 studies [18 RCTs], n=910). Pooling of 3 studies (n=63) showed walking training can improve fitness by 2.7 mL/kg/min (95% CI 0.64 to 4.89). Cycling training did not show any significant difference based on 2 studies with strong heterogeneity (MD 1.84 ml/kg/min, 95% CI −1.06 to 4.73, I^2 = 73%). Another multicentre trial of 200 subacute (day 5-45) stroke patients with moderate to severe disability (Barthel Index <65) found aerobic fitness training via treadmill with bodyweight support at target heart rate for 25 minutes, 5 times weekly for 4 weeks in addition to usual therapy (Nave et al 2019 *[109]*). No difference compared to the control group who got relaxation therapy was found for ADL or walking speed (fitness levels was not a primary outcome). Exploratory secondary outcomes were not different apart form 6MWT at 3 months (mean adjusted difference 27m, 95% CI 0 to 54 m) which favoured aerobic fitness group. There were more adverse events noted in the fitness group including higher self reported falls, recurrent stroke (8 v 3), and readmission to acute care (14 v 5) although the reason for readmission was not clear. No serious adverse events occurred during intervention sessions.

Other reviews have looked at various parameters of fitness training. Boyne et al (2017)*[112]* included 20 studies mostly RCTs (15, n=598) for VO2 peak. Overall there was a positive effect of 2.2 mL/kg/min (95% CI 1.3 to 3.1). However there was moderate heterogeneity (I2=67%). Analysis found training intensity was correlated with effect which then reduced the heterogeneity (11 studies of moderate intensity: MD 1.6, 95% CI 0.8 to 2.4 versus 5 studies of high intensity: MD 3.8, 95% CI 2.4-5.2). Fitness levels at baseline was also found to strongly influence effects. The mode of training (seated/cycling vs walking) also impacted the effects with only walking training found to increase waling endurance and

speed. Quality of the studies varied with 16/20 RCTs, 2 cross over trials and 2 non randomised studies. No sensitivity analysis was conducted based on trial quality and trials did not specifically keep treatment parameters apart from intensity consistent.

Galloway et al (2019)*[113]* included 9 studies (n=279) of which 4 were RCTs. Most studies were found to have high risk of bias. All included people who were ambulant and were more than 6 months post stroke. Studies that included training at higher intensiities (72-85% HRR) demonstrated better improvements in fitness than training at lower intensities irrespective of session lengths or program length. However, length of program needs to ensure physiological adaptation (ie. >12 weeks).

Luo et al (2019)*[114]* included 17 studies (n=707). Eleven studies used treadmill walking and six used cycle ergometer. Sessions ranged from 25 to 50 mins, most occuring 3 times per week for 8-12 weeks. Pooling 15 studies (n = 646) showed fitness training improved VO2peak (SMD 0.56, 95% CI 0.40 to 0.72). No difference was found in subgroup analysis on time since stroke, intensity (< or > 70%), mode, duration of treatment. The effect size was consistent in sensitivity analysis related to quality of studies. Fourteen studies (n=581) also reported overall positive results of high intensity fitness training on walking endurance (6MWT SMD = 0.26, 95% CI 0.09 to 0.42). Subgroup analysis showed effect was found with higher intensities (>70% HRR) and only with treadmill training not cycle ergometer. Effects overall were robust related to quality of studies. There was no overall different in adverse events (falls, pain or skin injuries) based on 5 pooled studies.

Veldema et al (2020)*[110]* assessed the impact on cycling training. Three trials (n=183) compared training to no intervention with no overall effect as measured by load test on ergometer (SMD 0.38; 95% CI, -0.13 to 0.90). Similarly 11 studies (n=454) compared fitness training to other interventions with pooled effect on fitness outcomes (load test on ergometer, treadmill test, spirometer test, pulse oximeter test) with no significant difference and high heterogeneity (SMD 0.49; 95% CI, -0.04 to 0.98; I^2=81%).

Anjos et al (2022) *[470]* with 9 studies (n=375) found high-intensity interval training (HIIT) improved cardiorespiratory fitness compared to continuous aerobic training (peak oxygen uptake MD 3.82mL/kg/min, 95% CI 2.62 to 5.01; 4 studies, n= 91) and usual care (peak oxygen uptake SMD 0.47mL/kg/min, 95% CI 0.14 to 0.81; 4 studies, n= 239).

Fabero-Garrido et al (2022) *[471]* with 9 studies (n=463) found respiratory muscle training significantly increased inspiratory muscle strength (SMD 0.65, 95% CI 0.17 to 1.13; 9 studies, n=344; low quality evidence), inspiratory muscle endurance (SMD 1.19, 95% CI 0.71 to 1.66; 3 studies, n=81; low quality evidence), diagram thickness (paretic SMD 0.9, 95% CI 0.43 to 1.37; 3 studies, n=79; non-paretic SMD 0.5, 95% CI 0.05 to 0.95; 3 studies, n=79; moderate quality evidence) and peak expiratory flow (SMD 0.55, 95% CI 0.03 to 1.08; 3 studies, n=84; moderate quality evidence). There were no benefits on expiratory muscle strength (SMD 0.43, 95% CI -0.05 to 0.91; 7 studies, n= 301; low quality evidence) and forced expiratory volume at 1 second (SMD 0.55, 95% CI -0.04 to 1.13; 3 studies, n=84; moderate quality evidence). None of these effects observed immediately postintervention were retained at follow up.

Machado et al (2022) *[472]* with 14 mixed method studies (n=324) found cardiorespiratory training was maintained (ie, did not deteriorate >-1.0mL/kg/min) for the majority of patients at the short term (MD -0.19mL/kg/min, 95% CI -1.66 to 1.28; 10 studies), medium term (MD -0.61mL/kg/min, 95% CI -3.95 to 2.74; 2 studies) and long term (MD 0.00mL/kg/min, 95% CI -2.23 to 2.23; 4 studies) follow up assessments. The cardiorespiratory fitness training were 2-5 days per week over 4-13 weeks at moderate to high intensity (4 studies), high intensity (7 studies) and intervals of high intensity (3 studies).

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Cardiorespiratory training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Death End of intervention 9 Critical	Relative risk 1 (CI 95% 0.99 — 1.01) Based on data from 1,631 participants in 32 studies. [1] (Randomized controlled)		CI 95%	**Low** Due to serious risk of bias [2]	There were too few people in these studies who died to determine whether cardiorespiratory training made a difference to case fatality
Physical fitness -	Measured by: Peak VO_2	Difference:	**MD 3.4 higher**	**Moderate**	Cardiorespiratory

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Cardiorespiratory training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
peak VO_2 (ml/kg/min) End of intervention 8 Critical	(ml/kg/minute) High better Based on data from 438 participants in 9 studies. [3] (Randomized controlled)		(CI 95% 2.98 higher — 3.83 higher)	Due to serious risk of bias [4]	training improves physical fitness - peak VO_2 (ml/kg/min)
Mobility - gait endurance End of intervention 8 Critical	Measured by: 6 Minute Walk Test (metres) High better Based on data from 882 participants in 16 studies. [5] (Randomized controlled)	Difference:	**MD 33.41 higher** (CI 95% 19.04 higher — 47.78 higher)	**High** [6]	Cardiorespiratory training improves walking endurance
Disability - combined disability scales End of intervention 9 Critical	Measured by: Various: Functional Independence measurement, Barthel Index, Rivermead Mobility Index High better Based on data from 462 participants in 8 studies. [7] (Randomized controlled)	Difference:	**SMD 0.52 higher** (CI 95% 0.19 higher — 0.84 higher)	**Moderate** Due to serious inconsistency [8]	Cardiorespiratory training improves measures of ADL
HRQoL End of intervention 8 Critical	Based on data from 322 participants in 4 studies. [9] (Randomized controlled)	Four included studies (294 patients) examined HRQoL at end of intervention. Two used SF36 or SF12 and reported SMD 0.51 (0.20 to0.82). Two others used EuroQul EQ5D which was non-significantly improved MD 6.55 (-1.36 to 14.47)		**Low** Due to serious risk of bias, Due to serious inconsistency, Due to serious imprecision [10]	We are uncertain whether cardiorespiratory training improves or worsen HRQoL

1. Systematic review [95] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Incomplete data and/or large loss to follow up. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. Systematic review [95] . **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Risk mainly from one study (Jin 2013) which if removed effect remains.. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Low number of patients. **Publication bias: no serious.**
5. Systematic review [95] . **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: no serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Wide confidence intervals. **Publication bias: no serious.**
7. Systematic review [95] . **Baseline/comparator:** Control arm of reference used for intervention.
8. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:61%.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
9. Systematic review [95].
10. **Risk of Bias: serious. Inconsistency: serious.** The direction of the effect is not consistent between the 4 small trials that included QoL measures. **Indirectness: no serious. Imprecision: serious.** Low number of patients, Wide confidence intervals. **Publication bias: no serious.**

Attached Images

Good practice statement

Consensus-based recommendations

- All stroke survivors should commence cardiorespiratory training during their inpatient stay.
- Stroke survivors should be encouraged to participate in ongoing regular physical activity regardless of their level of disability.

Visual field loss

Visual field loss occurs in approximately 30–35% of stroke survivors (Stroke Foundation 2019 *[7]*; Stroke Foundation 2020 *[8]*), and usually affects half of the field of vision in both eyes (homonymous hemianopia). Visual impairments include diplopia (double vision), difficulties with ocular convergence (both eyes looking at the same point), impaired saccadic movement (both eyes looking from one point to another), oversensitivity to light, nystagmus (rapid involuntary rhythmic movement of eyes from midline to one side) and dry eyes. These impairments can result in significant functional difficulties with activities such as reading, writing, mobilising and driving. Pre-existing visual deficits should be clarified as many stroke survivors are elderly and normal visual loss is common.

There is currently insufficient evidence for either restitutive or compensatory strategies for visual dysfunction (such as Fresnel prism glasses, computer-based visual retraining programs or visual scanning) to make any recommendations on interventions.

Good practice statement

Consensus-based recommendations

- All stroke survivors should have an:
  - assessment of visual acuity while wearing the appropriate glasses, to check their ability to read newspaper text and see distant objects clearly;
  - examination for the presence of visual field deficit (e.g. hemianopia) and eye movement disorders (e.g. strabismus and motility deficit).

Practical Info

Before the first screening post-stroke:

1. The stroke survivor's current set of glasses should be tagged on masking tape on the arm of the glasses, with the "before the stroke date". This forms the baseline of vision prior to the stroke.
2. Attain the name and address of current eye provider, for the record. This history can be of value to the clinician delivering the first screening post-stroke.

First screening of visual function post-stroke:

Health professionals should understand that visual field loss can be very distressing for a patient.

All stroke survivors should have, at a minimum, a comprehensive screening and assessment of visual functions, using a standardised approach, to determine deficits of:

1. past eye history including diagnosed eye conditions
2. visual acuity, with glasses that may be used for reading or distant activities
3. eye movements to determine the presence of strabismus and motility deficits

4. visual fields (e.g. hemianopia).

The stroke survivor could be interviewed to gain an understanding of their average time spent on specific vision intensive applications prior to the stroke, such as:
a. Time spent on a computer screen
b. Time spent on a smart phone
c. Time spent reading newspapers, magazines and books
d. Time spent going to the movies (big screen)
e. Time spent driving a vehicle during the day time
f. Time spent driving a vehicle at night
g. Time spent reading in the evening
h. Time spent reading early morning

Screening results should be documented to ensure rehabilitation strategies accommodate deficits to visual function.

Daily living with visual field loss post stroke:

If light sensitivity becomes an issue, installing remote controlled solar shades can provide the stroke survivor with much needed additional comfort.

User training and safety needs to be provided for stroke survivors with visual field loss who are using a motorized wheelchair, and needs to cover the special needs of storke survivors with visual field loss.

Activity limitations

Amount of rehabilitation, cardiorespiratory fitness and specific physical activities (sitting, standing up, standing balance, walking, upper limb activity) are discussed separately below.

Sitting

Sitting balance difficulties are common after stroke, and sitting balance is a predictor of recovery. Sitting training interventions have included lateral weight transfer training, trunk exercises, body vibration, and practice of reaching beyond arm's length while sitting. The latter, ideally undertaken using everyday tasks (e.g. reaching for a cup) has the strongest theoretical basis and evidence with other approaches having limited or mixed results.

Strong recommendation

For stroke survivors who have difficulty sitting, practising reaching beyond arm's length while sitting with supervision/assistance should be undertaken. (Veerbeek et al. 2014 *[125]*)

Practical Info

- Give clear instructions so patient understands and agrees to treatment plans, progression, amount of practice and goals.
- Therapists should consider safety of patients with severe weakness.
- If a patient is to do unsupervised or semi-supervised practice, ensure they can communicate with staff as needed (e.g. the buzzer is near them, and patient/family know where staff are located, and how to contact them)
- Feedback about weight transfer or reaching length should be used to continue to motivate patients.
- Consider incorporating functional training (such as reaching out to pick up a cup from a table).
- For stroke survivors with very weak leg extensors on the affected side, sitting with the person's non-affected hip, shoulder and arm against a wall may be useful for encouraging extensor activity in the affected leg.

Evidence To Decision

Benefits and harms — Small net benefit, or little difference between alternatives

In a systematic review of all interventions aimed at improving sitting balance (6 trials, 150 participants), a significant effect was found only for interventions involving reaching beyond arm's length (Veerbeek et al. 2014 *[125]*. No harms were noted.

Certainty of the Evidence — Low

Best evidence comes from two moderate quality RCTs, but there are many trials of variable quality on this topic.

Values and preferences — No substantial variability expected

No variation in preferences was found or expected.

Resources and other considerations — No important issues with the recommended alternative

<u>Implementation considerations</u>
There is currently no clinical indicator for sitting balance collected in the National Stroke Audit. However, a clinical indicator is collected on whether, if a patient was mobilised during the admission, the method of mobilisation involved sitting.

Rationale

The clearest evidence based on systematic review of multiple studies is for practising reaching beyond arm's length to challenge balance (Veerbeek et al. 2014 *[125]*). Ideally, this should be undertaken using everyday tasks (e.g. reaching for a cup) to maximise benefits in everyday activities.

Clinical Question/ PICO

Population: Adults with stroke with difficulty with sitting balance
Intervention: Sitting balance training (reaching beyond arms length)
Comparator: Control

Summary

A systematic review by Veerbeek et al (2014) *[125]* included a broad range of physical therapy interventions for stroke rehabilitation, including 467 RCTs in total. Limited detail was reported for individual interventions, making it hard to determine the specifics of trials of sitting balance training with reaching beyond arms length. Pooled data from 6 studies (150 participants) showed significant improvements in reach distance, with a non-significant improvement in ground reaction force. A larger effect size for improving reach distance was found when only studies involving reaching beyond arms length (3 trials, 50 participants) were included.

Other systematic reviews have assessed the efficacy of sitting balance training. These are summarized below:

Bank et al (2016) *[123]* included 11 randomised controlled trials that investigated the addition of physiotherapy treatments to standard physiotherapy. The interventions in the included trials were not specific to sitting balance, including additional trunk exercises and standing exercise. No significant difference was seen on the Trunk Control test when pooling results from 5 trials, while meta-analysis of 4 trials reporting Trunk Impairment Scale results showed a significant improvement following additional physiotherapy. In all, 9 out of 11 trials showed significant improvements on a sitting balance measure. No intervention in the papers included in this systematic review clearly improved sitting balance, although this is not surprising, as no intervention seem to address the underlying problems of sitting balance.

Cabanas-Valdés et al (2013) *[129]* included 11 trials of trunk training exercises, with interventions including sitting training or trunk exercises. Specific details of the interventions were unclear. No meta-analysis was conducted due to small numbers of participants and variation in outcomes, but the review concluded that trunk training exercises improved sitting balance.

Sorinola et al (2014) *[126]* included 6 randomised trials with 155 subjects in a systematic review of trials adding trunk exercises to conventional rehabilitation. Meta-analysis showed no significant differences on trunk performance, standing balance and functional independence, but a significant improvement of walking ability. It is possible that the improvements in standing balance and walking found in this review have nothing to do with the intervention. From a task specificity perspective it is improbable that training trunk muscles will improve standing or walking as the muscles of the base of support in sitting are different from those involved in standing and walking. These findings might be a factor of the low subject numbers (28 and 34 respectively) in the intervention groups and variability.

Dae-Sik et al (2014) *[127]* reviewed 6 trials of lumbar stabilisation. No meta-analysis was performed but the authors concluded that lumbar stabilisation exercises improve balance.

Subsequent to these systematic reviews, 4 ~~3~~ recent small randomised trials have assessed interventions such as training on a tilted platform, weight-shift training, ~~and~~ combined TENS and task-related trunk training, and robot assisted trunk control training (Fujino et al 2016 *[130]*; Chan et al 2015 *[124]*; Kim et al 2014 *[128]*; Kim et al 2022 *[466]*). These small trials provide limited evidence for the effects of the interventions on sitting balance.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Sitting balance	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Sitting while reaching beyond arms length 7 Critical	Measured by: Reach distance, sitting equilibrium test High better Based on data from 50 participants in 3 studies. (Randomized controlled) Follow up: Unclear.	Difference:	**SMD 2.47 higher** (CI 95% 0.84 higher — 4.11 higher)	Moderate Due to serious imprecision, Due to serious inconsistency [1]	Sitting balance probably improves sitting while reaching beyond arms length
Ground reaction		Difference:	**SMD 4.18 higher**	Low	Sitting balance may have

Outcome Timeframe	Study results and measurements	Comparator Control	Intervention Sitting balance	Certainty of the Evidence (Quality of evidence)	Plain language summary
force 7 Critical	High better Based on data from 50 participants in 6 studies. (Randomized controlled) Follow up: Unclear.		(CI 95% 0.17 lower — 8.53 higher)	Due to serious imprecision, Due to serious inconsistency [2]	little or no difference on ground reaction force

1. **Inconsistency: no serious.** The magnitude of statistical heterogeneity was high, with I^2:74%.. **Indirectness: no serious. Imprecision: serious.** Wide confidence intervals, Low number of patients. **Publication bias: no serious.**
2. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:94%.. **Indirectness: no serious.** Early rehabilitation phase only. **Imprecision: serious.** Wide confidence intervals, Low number of patients. **Publication bias: no serious.**

Attached Images

Standing up from sitting

The ability to transfer from sitting to standing (and then walking) is an important aspect of functioning after a stroke. Therapy generally includes practice standing up, along with other interventions (e.g. strength training). Practising standing up can be done to combine strength training for leg muscles along with functional practice. Two Cochrane reviews have been undertaken in this area including repetitive task practice (French et al. 2016 *[232]*) and general interventions to improve sit-to-stand (Pollock et al. 2014 *[134]*). Other interventions such as biofeedback can be used to enhance training and improve standing up (Stanton et al. 2011 *[144]*).

Strong recommendation

For stroke survivors who have difficulty in standing up from a chair, practice of standing up should be undertaken. (Pollock et al. 2014 *[134]*; French et al. 2016 *[232]*)

Practical Info

Evidence supports repetitive sit-to-stand training to improve sit-to-stand performance. Effective approaches may include repetitive sit-to-stand training as part of a broader exercise program or the use of biofeedback devices (Pollock et al 2014 *[134]*). Most studies investigating participants who were already able to stand independently and looked at the time taken to stand up or the symmetry of standing up (e.g. weight-bearing through the affected lower limb) as outcomes. While there is insufficient evidence on the duration and intensity of training, studies typically have provided 30 to 60 minutes training, 3 to 5 times a week for between 2 to 4 weeks.

In individuals who are not able to independently stand up from sitting, the following approaches may be considered:

- Performing squats on a sliding or fixed tilt table (de Sousa et al 2019 *[135]*)
- Performing reaching tasks in sitting, with emphasis on loading the more affected lower limb (de Sousa et al 2019*[135]*; Dean et al 2007)

To progress training and provide an appropriate level of challenge, clinicians may consider:

- Increasing number and speed of repetitions
- Lowering the height of the sitting surface
- Altering foot position to increase load through the more affected lower limb
- Provide progressively unstable surface under the feet (e.g. foam)

(de Sousa et al 2019 *[135]*; Britton et al 2008; Barecca et al 2004)

Other considerations for motivation, movement quality and safety during training are:

- Performing the training independently or in a group setting
- Providing visual targets (e.g. for shoulder or leg position) (de Sousa et al 2019 *[135]*)
- Using an external device for visual or auditory feedback (e.g. on lateral symmetry) (Cheng et al 2001; Britton et al 2008)
- Monitoring or counting repetitions
- Providing hands-on or verbal feedback on quality of movement
- Having a wall on the unaffected side for safety or to assist vertical perception (de Sousa et al 2019 *[135]*)
- Considering the appropriate environmental set up and level of challenge for those who may be fearful of falling

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

Sit-to-stand training does not seem to increase falls, therefore benefits outweigh harms. A Cochrane review (French et al. 2016 *[232]*) found moderate benefits for repetitive task practice (SMD 0.35), with another Cochrane review (Pollock et al. 2014 *[134]*) in agreement.

Certainty of the Evidence

Low

Quality of evidence was moderate to low.

Values and preferences

No substantial variability expected

No substantial variability in preference anticipated.

Resources and other considerations

No important issues with the recommended alternative

Implementation considerations

A clinical indicator is collected in the National Stroke Audit to determine if a patient was mobilised during their admission and whether the method of mobilisation involved standing.

Rationale

Two Cochrane reviews (French et al. 2016 *[232]*, Pollock et al. 2014 *[134]*) found specific sit-to-stand training improves the ability to stand up from sitting. Sit-to-stand practice is often included as a key part of other interventions, e.g. task-specific walking training and circuit class therapy.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Interventions for improving sit to stand
Comparator: Control

Summary

In a Cochrane review, Pollock et al (2014) *[134]* assessed interventions for improving sit-to-stand (STS) ability after stroke. 13 studies (n=603) were included. Interventions used in the trials included repetitive STS training, exercise programs that included STS training, sitting training and augmented feedback. Only 1 study with high risk of bias (N = 48) used ability to STS independently as an outcome, reporting significantly increased odds of independent standing following training (OR 4.86, 95% CI 1.43 to 16.50). Other measurements such as time taken to stand or lateral symmetry were reported in 7 and 5 trials respectively, and both showed significant improvements. The review authors concluded

that there was moderate quality evidence that interventions improved time taken to STS and lateral symmetry, but insufficient evidence to assess the benefits on standing independently.

Another Cochrane review by French et al (2016)*[232]* included seven studies (n=346) and found repetitive task-specific training has consistent, moderate benefits on the ability to stand from sitting (SMD 0.35, 95% CI 0.13 to 0.56).

Additional trials published since these reviews provide further evidence for the effectiveness of repetititve practice of sit to stand (STS). These trials compared slightly different ways of training STS and found:

- Compared with STS training with a symmetrical foot position, training STS with the affected leg positioned further back to the unaffected led to faster STS speed and better balance (Liu et al (2016)*[137]*)
- Compared with the same amount of training with a therapist providing manual assistance, use of an assistive device (the neurogym device) to practise STS led to greater independence in STS, and shorter time to complete the 5 x STS measure (indicating better functional leg strength) (Joey and Marc (2020)*[136]*).

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Interventions for improving sit to stand	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Ability to sit-to-stand independently Until hospital discharge 8 Critical	Odds ratio 4.86 (CI 95% 1.43 — 16.5) Based on data from 48 participants in 1 studies. [1] (Randomized controlled) Follow up: Until hospital discharge.	304 per 1000 Difference:	680 per 1000 **376 more per 1000** (CI 95% 80 more — 574 more)	**Low** Due to serious risk of bias, Due to serious imprecision, single study only [2]	Repetitive task specific training may slightly improve the ability to sit to stand independently
Falls (number of participants falling) During intervention 8 Critical	Odds ratio 0.75 (CI 95% 0.46 — 1.22) Based on data from 319 participants in 5 studies. [3] (Randomized controlled) Follow up: 2 to 12 weeks.	386 per 1000 Difference:	320 per 1000 **66 fewer per 1000** (CI 95% 162 fewer — 48 more)	**Moderate** Due to serious risk of bias [4]	There is probably little or no difference in falls between those undergoing sit to stand training and controls.
Time taken to stand or walk - Repetitive sit-to-stand interventions Post-intervention 7 Critical	Measured by: Time taken to sit-to-stand or sit-to-walk Lower better Based on data from 104 participants in 3 studies. [5] (Randomized controlled) Follow up: 2 to 12 weeks of treatment.	Difference:	**SMD 0.57 lower** (CI 95% 0.96 lower — 0.17 lower)	**Moderate** Due to serious risk of bias and influence of a single low quality study (Cheng) [6]	Repetitive sit-to-stand interventions probably decrease time taken to sit-to-stand or sit-to-walk
Time taken to stand or walk - Exercise programme interventions Post-intervention 7 Critical	Measured by: Time taken to sit-to-stand or sit-to-walk Lower better Based on data from 231 participants in 4 studies. [7] (Randomized controlled) Follow up: 2 to 12 weeks of treatment.	Difference:	**SMD 0.22 lower** (CI 95% 0.56 lower — 0.12 higher)	**Moderate** Due to serious risk of bias in 2 of 4 studies [8]	Exercise programme interventions probably have little or no difference on time taken to sit-to-stand or sit-to-walk

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Interventions for improving sit to stand	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Lateral symmetry - Repetitive sit-to-stand interventions Post-intervention 7 Critical	Measured by: Symmetry of weight distribution, lateral movement of centre of pressure during sit-to-stand High better Based on data from 84 participants in 3 studies. [9] (Randomized controlled) Follow up: 2 to 12 weeks of treatment.	Difference:	**SMD 0.62 higher** (CI 95% 0.18 higher — 1.07 higher)	**Low** Due to serious risk of bias and influence of a single low-quality study (Cheng 2001), Due to serious imprecision [10]	Repetitive sit-to-stand interventions may improve lateral symmetry
Time taken to sit-to-stand or sit-to-walk Follow-up after 6 months or more 8 Critical	Measured by: Time taken to sit-to-stand or sit-to-walk Lower better Based on data from 141 participants in 3 studies. [11] (Randomized controlled) Follow up: > 6 months.	Difference:	**SMD 0.48 lower** (CI 95% 0.88 lower — 0.08 lower)	**Low** Due to serious risk of bias; a single low quality study (Cheng) significantly influences overall confidence in pooled outcomes [12]	Sit to stand training may slightly improve performance at follow up after 6 months or more compared to controls

1. Systematic review [134] with included studies: Barreca 2004. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Only data from one study, Wide confidence intervals. **Publication bias: no serious.**
3. Systematic review [134] with included studies: FLASSH 2012, Barreca 2004, Mead 2007, Dean 2007, Cheng 2001. **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias possibly in 3 of 5 studies. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
5. Systematic review [134] . **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias in Cheng study, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
7. Systematic review [134] . **Baseline/comparator:** Control arm of reference used for intervention.
8. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias in two of four studies. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
9. Systematic review [134] . **Baseline/comparator:** Control arm of reference used for intervention.
10. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias in Cheng study, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
11. Systematic review [134] . **Baseline/comparator:** Control arm of reference used for intervention.
12. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias in Cheng and Mead studies. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Standing

Standing is an important determinant of performance of activities of daily living, which is a strong predictor of functional recovery and walking capacity and an important risk factor for falls (van Duijnhoven et al. 2016 *[153]*). Often after stroke, people regain their ability to stand however not always to full capacity, and with ongoing deficits in postural sway, weight transference, and maintaining their balance when influenced by external forces. These limitations can then impact on a person's ability to reach their goals in other areas of their physical rehabilitation (van Duijnhoven et al. 2016 *[153]*).

Strong recommendation

For stroke survivors who have difficulty with standing, activities that challenge balance should be provided (French et al. 2016 *[232]*, van Duijnhoven et al. 2016 *[153]*, Hugues et al. 2019 *[156]*).

Practical Info

Standing balance training should include practice of functional tasks or weight-shifting in standing as well as walking training that challenges balance. A range of approaches may additionally be used to achieve this, such as virtual reality training and Tai Chi, as long as the exercises are active, conducted in standing and challenge the balance system. Activities should be performed without hand support where possible, but safety and prevention of falling is paramount at all times.

While few adverse events are reported in the literature, care should be taken to minimise the risk of falls during balance training.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

The most recent Cochrane review by French et al (2016) *[232]* reported a small but statistically significant effect of repetitive task training on standing balance (SMD 0.24, 95% CI 0.07 to 0.42; 9 studies, n=504; moderate quality). There were few adverse events reported.

Certainty of the Evidence

Moderate

The quality of the evidence for this recommendation is moderate.

Values and preferences

No substantial variability expected

Practice balancing in standing would be expected by most people after stroke who have difficulty with balance. It is also seen as usual clinical practice.

Resources and other considerations

No important issues with the recommended alternative

Rationale

The most recent Cochrane review by French et al. (2016) [187] reported a small but statistically significant effect of repetitive task training on standing balance (SMD 0.24, 95% CI 0.07 to 0.42; 9 studies, n=504; moderate quality). Several other systematic reviews (van Duijnhoven et al. 2016 *[153],[125]* Hugues et al. 2019 *[156]*) have reported that exercise training that includes either practising functional tasks in standing, weight-shifting or walking training that challenges balance improves standing balance. Such training may also improve balance self-efficacy.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Repetitive task practice
Comparator: Control

Summary

The Cochrane review by French et al (2016) *[232]* reported a statistically significant effect of repetitive task training on standing balance (SMD 0.24, CI 95% 0.07 to 0.42; 9 studies, n=504; moderate quality). There were few adverse events reported, however, lack of formal reporting in included studies means this finding is inconclusive.

French et al. (2016) also conducted subgroup analyses for dosage, time since stroke, and type of intervention with the outcome of lower limb function *[232]*. Eight trials of 561 participants providing more than 20 hours of task practice showed a small but statistically significant effect size: SMD 0.33, 95% CI 0.16 to 0.50, and 16 trials of 583 participants providing 20 hours training or less reported a moderate and statistically significant effect: SMD 0.39, 95% CI 0.07 to 0.71. However, the difference in effects between these subgroups was not statistically significant (p=0.77). Similarly, there was no evidence to suggest different effects when interventions were delivered within 15 days, between 16 and 6 months, or more than 6 months after stroke. In terms of type of training, mixed training has a moderate and statistically significant effect (SMD 0.42, 95% CI 0.17 to 0.67), whereas results of single task and whole therapy approach did not reach statistical significance. However, the sample size for single task (n=112) and whole therapy approach (n=138) was comparatively small and there was no statistically significant difference between the three subgroups (p=0.21).

A further review by Hugues et al. (2019) *[156]* on physical therapy compared to no therapy to improve balance included 37 studies (n=1721). Of these 16 studies (n=386) specifically investigated functional task-training and found a moderate effect on balance post-intervention (SMD 0.54, 95%CI 0.33-0.75; low certainty evidence) which appeared to be maintained at follow up (SMD 0.60, 95% CI 0.23 to 0.96; four studies). Functional task-training included training specifically for balance, walking, sit-to-stand, transfers, or activities of daily living. The most commonly used measure was the Berg Balance Scale. A further 11 studies (n=778) included functional task-training AND musculoskeletal (e.g. strength or active range of movement) or cardiopulmonary interventions (e.g. fitness training). Post-intervention improvements were found (SMD 0.57, 95% CI 0.33 to 0.81, 5 studies) which was non-significant at follow up (SMD 0.22, 95%CI -0.04 to 0.47). The comparisons of physical therapy compared to sham treatment or usual care was similar but with lower effect (SMD 0.39 functional training alone; SMD 0.37 in combination).

A review by Scrivener et al (2020) included 22 studies (n=1,192) that compared a bobath approach to task-specific training. Overall task specific training was superior to Bobath on combined measures of lower limb activity (SMD 0.48, 95%CI 0.01 to 0.95; 9 trials, n=487). Two studies (n=160) with outcomes related to sit-to-stand found no difference in approaches (SMD 0.12, 95%CI -0.36 to 0.59). There was evidence that task specific training was superior to Bobath for walking outcomes.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Repetitive task practice	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Standing balance/reach Post-intervention 7 Critical	Measured by: various scales e.g. Upright Equilibrium Index, Berg Balance Scale, and Functional Reach High better Based on data from 504 participants in 9 studies. (Randomized controlled)	Difference:	**SMD 0.24 higher** (CI 95% 0.07 higher — 0.42 higher)	**Moderate** Due to serious risk of bias [1]	Repetitive task practice probably improves standing balance/reach

1. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Exercise training
Comparator: Control

Summary

A systematic review and meta-analysis by van Dujjnhoven et al (2016) *[153]* investigated the effects of exercise interventions (including functional standing and weight shifting activities, yoga, Tai Chi, walking training, virtual reality training and high-intensity aerobic training) and included 43 studies. There was an overall positive benefit of exercise therapy on improving functional measures of balance including the Berg Balance Scale (28 studies, n = 985; MD 2.22, 95% CI 1.26 to 3.17), the Functional Reach Test and the Sensory Organisation Test, with both immediate (post-intervention) and sustained effects (1 to 5 months follow-up). However, this review pooled together studies that had both matched training and additional training compared to the control. There was a differential effect based on type of intervention with functional standing and weight shifting activities (including Tai Chi), virtual reality and walking training showing a positive effect, but not high-intensity aerobic or multisensory training. Studies that included treadmill training with body-weight support or robotic training did not show significant improvements in balance.

A systematic review by Tang et al (2015) *[154]* included 19 RCTs (n=729) of any balance intervention and that included a measure of balance self-efficacy. They found significant effects in favour of active exercise interventions improving balance self-efficacy immediately after intervention (SMD 0.44, 95% CI 0.11 to 0.77) but not at follow-up (SMD 0.32, 95% CI −0.17 to 0.80). The review included four studies that used mental imagery as the intervention, and these did not lead to an improvement in balance self-efficacy (SMD 0.68, 95% CI −0.33 to 1.69).

Systematic reviews of trunk and core stability exercises (Gamble et al 2020*[165]*, Souza et al 2019*[132]*; Prat-Luri et al 2020*[166]*) have included studies investigating dynamic lying and sitting activities, lower limb strengthening and isolated trunk movements. There have found low-quality evidence that these types of exercises improve balance in standing. However, the studies which found a significant positive effects typically included components other than isolated trunk exercise, such as seated reaching, practiced in addition to usual care.

A review by Cabrera-Martos et al (2020) included 14 studies (n= 520) investigating the effects of core exercising for postural control compared to standardised supervised conventional program. No significant improvement was found for balance (MD 0.27, 95% CI -0.25 to 0.79; 6 studies, n= 251) and walking ability (MD -0.09, CI -0.49 to 0.31; 4 studies, n= 98). A significant improvement was found for trunk impairment (MD 0.98, CI 0.69 to 1.27; 6 studies, n= 210).

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Exercise training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Balance Post-intervention 7 Critical	Measured by: Berg Balance Scale High better Based on data from 985 participants in 28 studies. [1] (Randomized controlled)	Difference:	**MD 2.22 higher** (CI 95% 1.26 higher — 3.17 higher)	**Moderate** Due to serious inconsistency (significant heterogeneity). Subgroup analyses showed significant improvements following balance, weight-shifting and gait training interventions but not high intensity aerobic training. [2]	Exercise training probably improves balance

1. Systematic review [153] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: no serious.** The included trials were of moderate to high quality (PEDro scores 4 to 9). **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2: 52%.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Weak recommendation

For stroke survivors who have difficulty with standing, one or more of the following interventions may be used in addition to practising tasks that challenge balance:

- Virtual reality training, which may include treadmill training, motion capture or force sensing devices (e.g. Wii Balance Boards) (Zhang et al. 2021*[412]*; Laver et al. 2017 *[230]*)
- Visual or auditory feedback e.g. force platform biofeedback (Veerbeek et al. 2014 *[125]*; Stanton et al. 2017 *[155]*)
- Electromechanically assisted gait or standing training (Zheng et al. 2019 *[158]*)

Practical Info

Virtual reality may be defined as "an advanced form of human-computer interface that allows the user to 'interact' with and become 'immersed' in a computer-generated environment in a naturalistic fashion" (Corbetta et al. 2015 *[142]*). Examples of interventions include treadmill training with virtual reality and training with a Wii Balance Board. Ideally, virtual reality training would focus on activities that relate to the stroke survivor's goals, in order to keep them motivated and engaged.

Some stroke survivors may experience motion sickness on using a treadmill.

As with all hard surfaced equipment, cleaning between patient use should involve a wipe down with alcohol wipes or spray.

While few adverse events are reported in the literature, care should be taken to minimise the risk of falls during balance training, and additional vigilance is required during telehealth balance training.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Several interventions have been found to improve balance. Most have been provided in addition to standard, active practice. Studies either reported no or very minor adverse events(e.g. dizziness, headache or pain) using virtual reality training (Laver et al. 2017 *[230]*).

Certainty of the Evidence

Moderate

Certainty of evidence varies from low (robotics) to moderate (biofeedback, virtual reality therapy).

Values and preferences

No substantial variability expected

The working group felt people with stroke who have difficulty with balance would likely want the option to trial additional interventions to improve their balance.

Resources and other considerations

Important issues, or potential issues not investigated

Resource considerations

No literature to understand or describe the potential economic implications of this recommendation was identified. Not all sites will have access to some forms of VR training or robotics/electromechanically assisted training.

Rationale

Several meta-analysis (Zhang et al. 2021 *[412]*; Laver et al. 2017 *[230]*) consistently reported improved standing balance with

the use of virtual reality training in additional to conventional therapy (including treadmill training with virtual reality and training with a Wii Balance Board). Similarly, visual or auditory feedback led to a moderate improvement (SMD 0.50) in balance (Stanton et al. 2017 *[155]*) and was also found to improve measures of postural sway (Veerbeek et al. 2014 *[125]*). Electromechanically assisted training was also found to improve balance (Zheng et al. 2019 *[158]*). Finally, several recent meta-analysis of water-based exercises reported a small improvement in balance when directly compared to land-based training (Chae et al. 2020 *[162]*; Iliescu et al. 2020 *[159]*; Nascimento et al. 2020 *[161]*). However, improvements were under the minimal clinically important difference thresholds reported for stroke and as such no recommendation has been made.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Virtual reality
Comparator: Control

Summary

A review by Zhang et al (2021)*[412]* explored VR interventions with 87 studies and 3540 participants. VR improved balance measured by the Berg Balance Scale (MD 3.51, 95% CI 2.10 to 4.92; 21 studies, n= 633; high heterogeneity I^2= 80%) and walking ability through the outcome of Time Up and Go (TUG, MD -2.1, 95% CI -3.52 to -0.73; 17 studies, n= 457; moderate heterogeneity I^2= 64%).

A Cochrane review by Laver et al (2017)*[230]* included 72 studies (n=2470). Three studies (n=72) comparing VR training to conventional therapy failed to show statistical improvements in balance (SMD 0.39, 95%CI -0.09 to 0.86) although numbers were small and confidence intervals wide. When VR training plus conventional therapy was compared to conventional therapy alone there was a moderate effect on the Berg Balance Scale (SMD 0.59, 95%CI 0.28 to 0.90; 7 studies, n=173).

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Virtual reality	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Balance Post-intervention (4-12 weeks of treatment) 7 Critical	Measured by: Berg Balance Scale Scale: 0 — 56 High better Based on data from 633 participants in 21 studies. [1] (Randomized controlled)	Difference:	**MD 3.51 higher** (CI 95% 2.1 higher — 4.92 higher)	**Low** Due to serious inconsistency, Due to serious risk of bias [2]	Virtual reality based training may improve balance
Mobility Post-intervention (2-12 weeks of treatment) 7 Critical	Measured by: Timed Up and Go (seconds) Lower better Based on data from 457 participants in 17 studies. (Randomized controlled) Follow up: 2-12 weeks of treatment.	Difference:	**MD 2.1 lower** (CI 95% 3.52 lower — 0.73 lower)	**Low** Due to serious risk of bias, Due to serious inconsistency [3]	Virtual reality based training may improve mobility

1. Systematic review [412] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** From the PEDro scores, the studies were of fair to good quality. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2: 80 %.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. **Risk of Bias: serious.** From the PEDro scores, the studies were of fair to good quality. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2: 64%.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Biofeedback
Comparator: Control

Summary

An update of a previous systematic review by Stanton et al. (2017)*[155]* included 18 studies (n=429). Unlike the previous review (Stanton et al. 2011 *[144]*) only studies with higher quality (PEDro score >4/10) were included hence there were slightly less studies overall (18 vs 22). Biofeedback interventions used in the trials included giving visual or auditory feedback on ground reaction force using a force platform or foot sensor (14 studies), visual or auditory feedback on muscle activity using EMG (three studies), and joint position via an electrogoniometer (1 study). Visual feedback was used in seven trials; auditory in seven trials; and a combination of both in four trials. The mean duration of intervention sessions was 33 minutes (SD 17), occurring with a mean frequency of 3.7 days per week (SD 1.6), and a mean duration of 5.2 weeks (SD 2.2). Control groups mostly received usual therapy (presumably with therapist communication as feedback) and amount of practice was matched between intervention and control. The mean time after stroke ranged from < 1 month to 10 years, with 53% of the trials carried out <6 months after stroke and outcomes included measures of walking, standing balance and standing up. Pooling 17 studies (n=417) showed that lower limb activities were significantly improved following biofeedback (SMD 0.50, 95% CI 0.30 to 0.70).

Another systematic review with meta-analysis by Veerbeek et al. (2014) *[125]* also investigated the effects of the use of biofeedback in training standing balance. It was found that biofeedback leads to a significant improvement in postural sway in chronic stroke. It was found that biofeedback did not significantly improve balance, gait velocity or basic ADLs.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Biofeedback	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Lower limb activity measures [1] Post-intervention (3 to 8 weeks treatment) 8 Critical	Measured by: Various measures e.g. functional reach, Berg Balance Scale, walking speed, step/stride length High better Based on data from 417 participants in 17 studies. [2] (Randomized controlled) Follow up: 2-8 weeks.	Difference:	**SMD 0.5 higher** (CI 95% 0.3 higher — 0.7 higher)	**Moderate** Due to risk of bias [3]	Biofeedback improves lower limb activity measures

1. Various measures used for balance and walking
2. Systematic review [155] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious.** Differences between the outcomes of interest and those reported (e.g short-term/surrogate,not patient-important). **Imprecision: no serious. Publication bias: no serious.** The Systematic review used did not search for gray literature.

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Mechanical-assisted therapy / robotics
Comparator: Control

Summary

Zheng et al. (2019) *[158]* included 31 studies (n=1249) that compared robot or mechanical-assisted therapy to usual care. The duration of intervention ranged from three to twelve weeks (Mean 6 weeks). 23 studies (n=929) included the Berg Balance Score which improved in the intervention arm (MD 4.64, 95%CI 3.22 to 6.06, P<0.01; I^2>50%). Subgroup and sensitivity analysis was reassuring with no change to the effect for different types of robotic devices, if therapy was combine with other interventions, or by differences in duration and intensity.

A review by Wang et al (2021)*[416]* explored robot-assisted training with nineteen studies and 722 participants. Robot therapy significantly improved balance compared to conventional therapy (Berg Balance Score WMD 3.58, 95% CI 1.89 to 5.28; 13 studies, n= 517). Robot therapy had clear effect greater impact on balance (Berg balance score)in studies with participants less than 6 months after stroke(WMD 5.40, 95% CI 3.94 to 6.86; 7 studies, n= 354) but not in chronic patients (WMD 1.61, 95% CI -0.02 to 3.25; 5 studies, n= 129). In secondary analysis, exoskeleton robot therapy improved balance significantly compared to conventional treatment (MD 3.73, 95% CI 1.83 to 5.63; 10 studies, n= 389), while there was no significant difference between conventional and end-effector robot therapy (MD 3.08, 95% CI -1.47 to 7.63; 3 studies, n= 128). Subgroup analysis also suggested treatment of longer than 10 hours was effective whereas studies providing less than 10 hours was not statistically significant. Only two studies reported the presence of adverse effects, including leg pain (n= 6), pitting oedema (n= 1), presented with significant hypertension (n=1), withdrew due to subjective exercise intolerance in the control group (n=2), acute hospital care (n= 1) and deteriorating medical condition in the control group (n= 1).

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Mechanical-assisted therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Balance [1] End of intervention (3-12 weeks) 8 Critical	Measured by: Berg Balance Scale Scale: 0 — 54 High better Based on data from 929 participants in 23 studies. [2] (Randomized controlled) Follow up: mean 6 weeks.	Difference:	**MD 4.64 higher** (CI 95% 3.22 higher — 6.06 higher)	**Low** Due to serious risk of bias, Due to serious inconsistency [3]	Mechanical-assisted therapy may improve balance

1. Berg Balance Scale
2. Systematic review [158] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious.** Various major ROB. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2>50%.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Hydrotherapy
Comparator: Usual care

Summary

Several systematic reviews have been published all noting a potentially small effect which is below minimal clinical important difference and potentially even below minimal detectable change values.

Veldema et al. (2021) included 28 studies (n= 961). Pooled data from 17 studies (n= 572) for balance favoured water based exercise compared to conventional/land based exercises (ES 0.77, 95% CI 0.06 to 1.47). Pooled data from 4 studies (n= 96) for balance favoured water based exercise compared to no intervention (ES 0.90, 95% CI 0.04 to 1.76). Participants undertook training for 20-60 minutes, for between six and 40 sessions.

Ghayour Najafabadi et al. (2021) included 17 studies (n= 629). Pooled data from 15 studies (n= 364) found standard mean difference in BBS in favour of water based exercise compared to conventional/land based exercises (SMD 0.72, 95% CI 0.50 to 0.94; moderate heterogeneity I2= 67%). Participants undertook training for 30-60 minutes, 2-6/week, for 2 to 12 weeks.

Chae et al. (2020)*[162]* included 11 studies (n=325). The intervention ranged from 2 to 5 sessions, 30–60 mins each per week over 2 to 8 weeks. Most (7/10) studies involved participants in the chronic phase with 3/10 in subacute phase. Hydrotherapy was added to land-based exercise in two studies, but mainly compared to land-based and matched for duration and intensity. Pooled data from 10 studies (n=264) found a small but statistically significant difference with hydrotherapy (Berg Balance Scale [BBS] MD 1.59 points, 95%CI 1.00 to 2.19). This Is not considered a clinically meaningful difference. Subgroup analysis found this effect was only significant in the 7 chronic phase trials (BBS MD = 1.61, 95%CI 1.00 to 2.21), not a clinically meaningful difference but there was no significant effect of hydrotherapy compared to land-based therapy in the subacute studies (BBS MD = 1.04, 95%CI −2.62 to 4.70) . No adverse events were reported in the water-based groups but two events were noted in the land-based group.

Nascimento et al. (2020)*[161]* included 13 studies (n=464). Pooled data from five studies (n=135) found mean difference in BBS in favour of water based exercise compared to conventional/land-based exercises (MD 4.5 points, 95%CI 2.2 to 6.8). Participants undertook training for 30–60 minute, 2–5/weeks, for an average 7 weeks. The authors rated the overall quality (GRADE) as moderate.

Iliescu et al. (2020) included 17 RCTs and 2 controlled trials (n=676). Pooled data from eight studies (n=225) found mean difference in Berg Balance Scale in favour of water based exercise therapy (MD 2.25 points, 95%CI 1.17 to 3.33, P<0.001). This Is not considered a clinically meaningful difference.

Nayak et al. (2020) included 11 studies (10 RCT and 1 CCT; n=455). Pooled data from three studies (n=65) comparing water to land-based therapy favoured water exercises (BBS MD 3.23, 95%CI 1.06 to 5.39, medium heterogeneity I^2=61%; very low certainty evidence). Pooled data from four studies (n=141) comparing water plus land-based to land-based was not significantly difference (MD 0.30 points, 95%CI -0.29 to 0.90, medium heterogeneity I^2=66%; very low certainty evidence).

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Hydrotherapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Balance [1] End of intervention 8 Critical	Measured by: Berg Balance Scale Scale: 0 — 56 High better Based on data from 264 participants in 10 studies. [2] (Randomized controlled)	Difference:	**MD 1.59 higher** (CI 95% 1 higher — 2.19 higher)	**Moderate** Due to serious risk of bias [3]	Hydrotherapy probably improves balance slightly but is likely under the clinically minimal difference threshold

1. Berg Balance Scale
2. Systematic review [162] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious.** No concealment in 7/11 studies; no blinded assessors 4/11, Missing intention-to-treat analysis, no Intention to treat analysis in 3/11. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.**

Attached Images

Walking

Walking difficulty is common after stroke, with 56% of patients reported as unable to mobilise independently on admission to hospital (Stroke Foundation 2019 *[7]*). Overall there is extensive evidence from many systematic reviews on interventions to improve walking. Reviews tend to focus on specific interventions such as task-specific overground training, cueing of cadence, joint position feedback, electrical stimulation, virtual training, mental practice and use of an orthosis. Alternatively, reviews focus on ways to deliver the interventions, such as circuit class training, treadmill training, electromechanically assisted training, and community-based ambulation training.

This section should be read in conjunction with Weakness and Cardiorespiratory fitness; see also Spasticity and Contracture in the Managing complications chapter.

Strong recommendation

Stroke survivors with difficulty walking should be given the opportunity to undertake tailored repetitive practice of walking (or components of walking) as much as possible. (French et al. 2016 *[232]*)

The following modalities may be used:

- Circuit class therapy (with a focus on overground walking practice) (English et al. 2017 *[420]*);
- Treadmill training with or without body weight support (Mehrholz et al. 2017 *[413]*; Nascimento et al. 2021 *[411]*).

Practical Info

Observational studies and secondary analyses of trial data suggest that stroke survivors spend as little as 10 minutes or less engaged in practice of walking during therapy sessions (Kaur et al. 2012 *[184]*, English et al. 2014 *[102]*), and overestimation of time spent on activity in therapy is common (Kaur et al. 2013 *[34]*). Therefore, objective measurement of time spent practising walking using activity monitors, or auditing therapy sessions using video analysis can be useful.

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

Circuit class therapy improves walking endurance and independence with mobility following stroke (Veerbeek et al. 2014 *[24]*; English et al. 2010 *[?]*; van de Port et al. 2012 *[170]*).

Treadmill training with or without body weight support improves walking endurance and walking speed by a small amount following stroke, without any significant risk of harm (Mehrholz et al. 2017 ~~14~~ *[413]* ~~*[171]*~~). The evidence for treadmill training should be considered as a whole given that both forms – with body weight support and without body weight support – offer similar benefits. The mixed evidence profiles support its use to improve walking when both types are pooled together. However, treadmill training appears beneficial only for people able to walk independently at onset of therapy (Mehrholz et al. 2017 ~~4~~ *[413]* ~~*[171]*~~).

Certainty of the Evidence

High

The evidence profile for circuit class therapy and treadmill training was strong, and the certainty of effect estimates was high.

Values and preferences — No substantial variability expected

Resources and other considerations — No important issues with the recommended alternative

Implementation considerations

A clinical indicator is collected in the National Stroke Audit to determine if a patient was mobilised during their admission and whether the method of mobilisation involved walking.

Rationale

One previous high-quality review (French et al. 2007 *[142]*) found repetitive, task-specific training improved walking distance, speed and ADL. Circuit class therapy and treadmill training are interventions that are supported by systematic reviews, which had high certainty of effect estimates (high-quality evidence profiles) for improving walking ability, probably via providing greater opportunities for walking practice. For this reason, these interventions were grouped and classed as a strong recommendation.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Circuit class therapy
Comparator: Usual care

Summary

An updated Cochrane review by English et al (2017)*[420]* included 17 studies (n=1297). Circuit class therapy improved walking speed (MD 0.15 m/s 95% CI 0.10 to 0.19; 8 studies, n=744; GRADE: moderate) and walking capacity (Six-Minute Walk Test MD 60.86 m, 95% CI 44.55 to 77.17; 10 studies, n=835; GRADE: moderate). Circuit class therapy also improved participants with independent mobility (OR 1.91, 95%CI 1.01 to 3.6; 3 studies, n=469; GRADE moderate). There was a no significant increase in falls related adverse events (RD 0.03, 95% CI -0.02 to 0.08; 8 studies, n=815; GRADE: very low). There was no difference in effects found for time after stroke or size and quality of included studies.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Circuit therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Independent mobility 7 Critical	Odds ratio 1.91 (CI 95% 1.01 — 3.6) Based on data from 469 participants in 3 studies. [1] (Randomized controlled)	472 per 1000 Difference:	631 per 1000 **159 more per 1000** (CI 95% 2 more — 291 more)	Moderate Risk of bias in some studies	Circuit therapy probably increases independent mobility
Walking speed 9 Critical	Measured by: 10 metre walk test, Walking speed gait analysis High better Based on data from 744 participants in 8 studies. [2] (Randomized controlled)	Difference:	**MD 0.15 higher** (CI 95% 0.1 higher — 0.19 higher)	Moderate Risk of bias in some studies [3]	Circuit therapy probably increases walking speed
Walking endurance [4]	Measured by: 6MWT - 6 minute walk test (walking distance)	Difference:	**MD 60.86 higher** (CI 95% 44.55 higher — 77.17	Moderate Risk of bias in some studies	Circuit therapy probably increases walking endurance

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Circuit therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
8 Critical	High better Based on data from 835 participants in 10 studies. [5] (Randomized controlled)		higher)		

1. Systematic review. **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [420],
2. Systematic review [420] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
4. 6min WT
5. Systematic review. **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [420],

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Treadmill (with or without body weight support)
Comparator: Usual care (walking training without mechanical assistance)

Summary

In a Cochrane review, Mehrholz et al (2017) *[413]* included 56 randomised and quasi-randomised trials and cross-over trials(N = 3105) of treadmill training and body weight support, together or in combination. Walking velocity was significantly increased by 0.06 m/s following treadmill training (95% CI 0.03 to 0.09; 47 studies, n= 2323; moderate quality evidence). and walking endurance (MD 14.19m, 95% CI 2.92 to 25.46;28 studies, n= 1680; moderate quality evidence), but did not significantly increase the chances of walking independently (risk difference 0.0, 95% CI -0.02 to 0.02; 18 studies, n= 1210; low quality evidence). In participants who were independent in walking at study onset, the use of treadmill increased walking velocity significantly (MD 0.08m/s, 95% CI 0.05 to 0.12; 38 studies, n= 1571). The review authors concluded that treadmill training may improve walking speed and walking endurance, with greater benefits for stroke patients who are able to walk already.

A review by Nascimento et al 2021*[411]* investigated treadmill walking with sixteen trials and 713 patients. Compared to no/non-walking interventions, treadmill walking increased walking speed by 0.13 m/s (95% CI 0.08 to 0.19; 6 studies, n= 266; moderate quality evidence) and was sustained post-intervention (MD 0.14m/s, 95% CI 0.01 to 0.26; 3 studies, n= 118; moderate heterogeneity I^2=78%; low quality evidence). Walking distance significantly increased by 46m (95% CI 24 to 68; 6 studies, n= 235; moderate quality evidence) and the effect was maintained post-intervention (MD 30m, 95% CI 10 to 50; 3 studies, n= 118). When comparing treadmill walking and overground walking, walking speed (MD 0.07m/s, 95% CI 0.00 to 0.13, 6 studies, n= 196; moderate quality evidence) and distance (MD 18m, 95% CI 1 to 36; 6 studies, n= 210; moderate quality evidence) were both found to be similar or somewhat better for treadmill walking.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Treadmill (with or without body weight support)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Walking Endurance 7 Critical	Measured by: Six Minute Walk Test High better Based on data from 1,680 participants in 28 studies. [1] (Randomized controlled)	203.7 meters (Mean) Difference:	223.78 meters (Mean) **MD 14.19 higher** (CI 95% 2.92 higher — 25.46 higher)	Moderate	Treadmill training (with or without body weight support) significantly improved walking endurance.
Walking Speed 7 Critical	Measured by: Walking speed High better Based on data from 2,323 participants in 47 studies. (Randomized controlled)	0.59 m/s (Mean) Difference:	0.66 m/s (Mean) **MD 0.06 higher** (CI 95% 0.03 higher — 0.09 higher)	Moderate	Treadmill training (with or without body weight support) significantly improved walking speed by a small to moderate amount.

1. Systematic review [413] . **Baseline/comparator:** Control arm of reference used for intervention.

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Repetitive task practice
Comparator: Usual care/attention control/no treatment

Summary

The most recent systematic review by French et al (2016) reported a statistically significant small to moderate effect of repetitive task training on walking distance and functional ambulation *[232]*. The difference of walking speed did not reach statistical significance, but that could be contributed by the choice of outcome measure of the mean walking speed. It would have been more appropriate to use change from the baseline as the outcome measure, especially for analyses with smaller sample size. However, it was not reported in all trials and standard mean difference was used instead. There were few adverse events reported, however, lack of formal reporting in included studies means this finding is inconclusive.

French et al also conducted subgroup analyses for dosage, time since stroke, and type of intervention *[232]*. Eight trials of 561 participants providing more than 20 hours of task practice showed a moderate and statistically significant effect size: SMD 0.33, 95% CI 0.16 to 0.50, and 16 trials of 583 participants providing 20 hours training or less reported a small and statistically significant effect: SMD 0.39, 95% CI 0.07 to 0.71. However, the difference in effects between these subgroups was not statistically significant (P = 0.77). Similarly, there was no evidence to suggest different effects when interventions were delivered within 15 days, between 16 and 6 months, or more than 6 months after stroke. In terms of type of training, mixed training has a moderate and statistically significant effect (SMD 0.42, 95% CI 0.17 to 0.67), whereas results of single task and whole therapy approach did not reach statistical significance. However, the sample size for single task (N = 112) and whole therapy approach (N = 138) was comparatively small and there was no statistically significant difference between the three subgroups (P = 0.21).

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care/ attention control/no treatment	**Intervention** Repetitive task practice	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Walking distance - change from baseline end of treatment 7 Critical	Measured by: 6 Minute Walk Test High better Based on data from 610 participants in 9 studies. (Randomized controlled)	(n/a) Difference:	(n/a) **MD 34.8 higher** (CI 95% 18.19 higher — 51.41 higher)	**Moderate** Due to serious risk of bias [1]	Repetitive task practice probably increases walking distance - change from baseline
Walking speed end of treatment 7 Critical	Measured by: 10/5/6 Meter Walking Speed High better Based on data from 685 participants in 12 studies. (Randomized controlled)	Meters per second (n/a) Difference:	Meters per second (n/a) **SMD 0.39 higher** (CI 95% 0.02 lower — 0.79 higher)	**Low** Due to serious risk of bias, Due to serious inconsistency [2]	Repetitive task practice may increase walking speed
Functional ambulation end of treatment 7 Critical	Measured by: various measures such as Functional Ambulation Classification High better Based on data from 525 participants in 8 studies. (Randomized controlled)	Difference:	**SMD 0.35 higher** (CI 95% 0.04 higher — 0.66 higher)	**Moderate** Due to serious risk of bias [3]	Repetitive task practice probably improves functional ambulation

1. **Risk of Bias: serious.** random sequence generation unclear in 6/ 9 trials in the meta-analysis; allocation concealment unclear in 6/ 9 trials and high risk in 3/ 9 trials). **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.**
2. **Risk of Bias: serious.** random sequence generation unclear in 7/ 12 trials in the meta-analysis; allocation concealment unclear in 9/ 12 trials and high risk in 3/12 trials). **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:80%.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. **Risk of Bias: serious.** random sequence generation unclear in 4/ 8 trials in the meta-analysis; allocation concealment unclear in 7/ 8 trials and high risk in 1/ 8 trials. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Weak recommendation

In review

For stroke survivors with difficulty walking, one or more of the following interventions may be used in addition to those listed above:

- Virtual reality training. (Zhang et al. 2021 *[412]*)
- Electromechanically assisted gait training. (Mehrholz et al. 2020 *[175]*)
- Biofeedback. (Stanton et al. 2017 *[155]*)
- Cueing of cadence. (Nascimento et al. 2015 *[176]*)
- Electrical stimulation. (Howlett et al. 2015 *[177]*)

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Virtual reality training improves walking speed following stroke (Zhang et al. 2021 *[412]*)

Electromechanically assisted gait training when used with in combination with usual physiotherapy improves independence with mobility after stroke and had low incidence of harm (Mehrholz et al. 2020 *[175]*).

Various modes of biofeedback (when all data is pooled) may improve gait parameters after stroke (Stanton et al. 2017 *[155]*).

Cueing of cadence may improve walking speed after stroke (Nascimento et al. 2015 *[176]*).

Electrical stimluation when applied functionally may improve walking speed by a small amount (Howlett et al. 2015 *[177]*).

Certainty of the Evidence

Low

Electromechanically assisted gait training and electrical stimulation had moderate certainty in effect estimates, while cueing of cadence, and biofeedback had low certainty in effect estimates.

Values and preferences

Substantial variability is expected or uncertain

Different types of therapy may have variation in patient preference and values.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Implementation considerations

There are clinical indicators collected in the National Stroke Audit on whether a patient's management for a mobility impairment included the cueing of cadence, joint position biofeedback or mechanically assisted gait (via mechanical or robotic device).

Rationale

Virtual reality training, electromechanically assisted gait training, biofeedback, cueing of cadence, and electrical stimulation may improve walking ability, however there is a lower certainty of effect estimates compared to circuit class therapy and treadmill training.

Various types of virtual reality training were included in the reviews that support its use for walking after stroke. The evidence does not support a single type of system, however it does support its use in general. This should be taken into account when considering the evidence.

Clinical Question/ PICO

Population: Electromechanical-assisted training for walking after stroke
Intervention: Electromechanical assisted gait training in combination with physiotherapy
Comparator: Physiotherapy (or usual care)

Summary

Mehrholz et al (2020) *[175]* conducted a Cochrane review of electromechanical-assisted interventions for improving walking after stroke. Sixty two trials with 2440 total participants were included. Intervention used in the trials used

electromechanical assisted gait training in addition to physiotherapy. Participants were significantly more likely to be independent in walking following electromechanical-assisted training (OR 2.01, 95% CI 1.51 to 2.69; 38 studies, n= 1567; high quality evidence), with subgroup analyses suggesting that patients in the acute phase of stroke were likely to benefit (OR 1.96, 95% CI 1.47 to 2.62; 24 studies, n= 1243) but showing no significant benefit for patients in the chronic phase. Electromechanical-assisted interventions increased walking velocity at the end of the intervention (MD 0.06m/s, 95% CI 0.02 to 0.01; 42 studies, n= 1600; moderate heterogeneity I^2= 60%; low quality evidence) but not on follow up (MD 0.07m/s, 95%CI -0.03 to 0.17; 13 studies, n=727; low quality evidence). There was no significant difference on walking capacity (MD 10.9 metres walked in 6 minutes, 95% CI -5.7 to 27.4; 24 studies, n= 983; moderate quality evidence).

Bruni et al (2018)*[191]* conducted a review with 13 studies (n= 673) and found end-effector device was effective in improving walking speed when compared to conventional rehabilitation (SMD 0.38, 95% CI 0.21 to 0.55; 7 studies, n= 469) and the effect was consistent when specifically investigating in the sub-acute phase (SMD 0.48, 95% CI 0.23 to 0.71; 5 studies, n= 339). Exoskeleton robot was not more effective than conventional therapy (SMD -0.12, 95% CI -0.38 to 0.14; 6 studies, n= 218) and in the subacute phase the difference was not significant (SMD 0.12, 95% CI -0.18 to 0.42; 4 studies, n= 181). When investigating the chronic phase, no significant difference was found for either of the robotic treatments, end-effector devises (SMD -0.05, 95% CI -0.44 to 0.34; 2 studies, n= 130) or exoskeleton devices (SMD -0.13, 95% CI -0.74 to 0.48; 2 studies, n= 37).

A review by Lo et al (2017)*[190]* with 51 studies (n= 1798) examined the effect of upper and lower limb robotic interventions. No significant result was found for lower limb mobility (SMD 0.17, 95% CI -0.15 to 0.48; 15 studies, n= 701; moderate heterogeneity I^2= 75%; high quality evidence). For patients with severely impaired lower limbs a significant difference was found in favour of robotics (SMD 0.41, 95% CI 0.19 to 0.63; 10 studies, n= 510; high quality evidence), but no significant results was observed for the sustainability of the treatment effect post intervention (SMD 0.3, 95% CI -0.05 to 0.65; 6 studies, n= 408; high quality evidence).

The review by Shen et al (2018)*[192]* explored the effects of MOTOmed, a supplement system for sports and movement therapy with conventional rehabilitation using 19 studies and 1099 participants. Improvement was found in activities of daily living using the Barthel Index (MD 14.82, 95% CI 12.96 to 16.68; 8 studies, n= 510) and the Modified Barthel Index (MD 11.49, 95% CI 8.96 to 14.03; 2 studies, n= 68), functional ambulation (MD 0.85, 95% CI 0.68 to 1.03; 4 studies, n= 297) and the 10-meter walk test (MD 10.15, 95% CI 5.72 to 14.58; 3 studies, n= 199).

Outcome Timeframe	**Study results and measurements**	**Comparator** Physiotherapy (or usual care)	**Intervention** Electromechanical assisted gait training and physiotherapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Ability to walk independently [1] At end of intervention phase 9 Critical	Odds ratio 2.01 (CI 95% 1.51 — 2.69) Based on data from 1,572 participants in 18 studies. [2] (Randomized controlled) Follow up: Varied: 10 days to 8 weeks.	451 per 1000 Difference:	623 per 1000 **172 more per 1000** (CI 95% 103 more — 237 more)	**High** Due to risk of bias, Upgraded due to Large magnitude of effect [3]	Electromechanical assisted gait training probably improves the ability to walk independently following stroke.
Adverse events - death (risk difference) [4] End of intervention 7 Critical	Relative risk 0 (CI 95% -0.01 — 0.01) Based on data from 2,440 participants in 62 studies. [5] (Randomized controlled) Follow up: Varied: 10 days to 8 weeks.	2 per 1000 Difference:	3 per 1000 **1 more per 1000** 8 fewer — 12 more	**Moderate**	Electromechanical assisted gait training does not increase the risk of adverse events following stroke.
Walking speed [6] End of followup	Measured by: Walking speed (m/s) High better	0.57 m/sec (Mean)	**MD 0.07 higher** (CI 95% 0.03 lower — 0.17	**Low**	Electromechanical assisted gait training probably does not

Outcome Timeframe	**Study results and measurements**	**Comparator** Physiotherapy (or usual care)	**Intervention** Electromechanical assisted gait training and physiotherapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
8 Critical	Based on data from 727 participants in 13 studies. [7] (Randomized controlled) Follow up: Varied: 10 days to 8 weeks.	Difference:	higher)		improve walking speed.

1. Independent walking at the end of intervention phase, all electromechanical devices used
2. Systematic review [175] with included studies: Mayr 2008, Hidler 2009, Saltuari 2004, Pohl 2007, Tong 2006, Fisher 2008, Kyung 2008, Morone 2011, Noser 2012, Westlake 2009, Schwartz 2006, Aschbacher 2006, Husemann 2007, Peurala 2009, Van Nunen 2012, Dias 2006, Chang 2012, Tanaka 2012, Hornby 2008, Peurala 2005, Geroin 2011, Brincks 2011, Werner 2002. **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious.** due to 49% of participants could walk independently at start of trials.. **Upgrade: large magnitude of effect.**
4. Death from all causes until the end of intervention phase. Mehrholz (2013) reports this as a risk difference.
5. Systematic review [175] with included studies: Kyung 2008, Geroin 2011, Peurala 2009, Noser 2012, Fisher 2008, Mayr 2008, Chang 2012, Hornby 2008, Tanaka 2012, Brincks 2011, Peurala 2005, Dias 2006, Hidler 2009, Aschbacher 2006, Werner 2002, Tong 2006, Schwartz 2006, Morone 2011, Westlake 2009, Husemann 2007, Van Nunen 2012, Pohl 2007, Saltuari 2004. **Baseline/comparator:** Control arm of reference used for intervention.
6. Walking velocity (metres per second) at the end of followup
7. Systematic review [175] with included studies: Pohl 2007, Peurala 2005, Saltuari 2004, Tanaka 2012, Noser 2012, Husemann 2007, Tong 2006, Geroin 2011, Fisher 2008, Westlake 2009, Van Nunen 2012, Brincks 2011, Morone 2011, Hornby 2008, Werner 2002, Hidler 2009, Kyung 2008. **Baseline/comparator:** Control arm of reference used for intervention.

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Electrical stimulation
Comparator: Control (walking training alone)

Summary

A systematic review by Howlett et al (2015) *[177]* included trials of functional electrical stimulation (FES) for improving upper or lower limb activity compared to placebo, no treatment or training alone. Eighteen trials were included with 485 total participants. Comparing FES to training alone using results from 203 participants in 8 trials showed a significant improvement in walking speed of 0.08 m/s (95% CI 0.02 to 0.15). However, there was a high risk of bias in many of the included trials, with a lack of blinding for outcome assessors and a lack of intention-to-treat analysis.

A review by Hong et al (2018)*[212]* included twenty-one trials of neuromuscular electrical stimulation (NMES) for improving lower limb activity compared to a control group of no electrical stimulation present (n=1481). The pooled analysis of 21 studies with 23 comparisons and 1239 participants showed a statistically significant improvement in gait speed (SMD 0.41, 95% CI 0.22 to 0.61; 14 studies; n= 1020), however, no significant difference was found for walking endurance (MD 5.84, 95% CI -2.60 to 14.29; 7 studies, n= 738).

da Cunha (2021)*[202]* with 14 studies explored FES applied to the paretic peroneal nerve on gait speed (n= 1115). For gait speed, FES combined with supervised exercises was better than supervised exercise alone (SMD 0.51, 95% CI 0.16 to 0.86; 5 studies, n= 133; low quality), but FES did not enhance gait speed compared to conventional treatments (SMD 0.092, 95% CI -0.34 to 0.53; 12 studies, n= 1077; moderate heterogeneity I2= 89%; low quality).The stimulation

sessions ranged from 20-60 minutes, 1-7/week, for 1 day to 30 weeks.

da Cunha et al. (2021)*[202]* conducted a review with 14 studies (n= 1115) investigating functional electrical stimulation (FES) of the peroneal nerve. Meta-analysis showed FES did not enhance walking speed (SMD 0.092, 95% CI -0.34 to 0.53; 12 studies, n= 1077; high heterogeneity I2= 89%; low quality evidence) compared with conventional treatments. Further analysis found when FES was combined with physiotherapy walking speed improved compared to physiotherapy (SMD 0.51, 95% CI 0.16 to 0.86; 4 studies, n= 133; low quality evidence).

Nascimento et al (2020)*[193]* explored ankle-foot orthose (AFO) and functional electrical stimulation (FES) using 11 studies and 1135 participants. Walking speed significantly increased when compared to no intervention/placebo for FES (MD 0.09m/s, 95% CI 0.03 to 0.14; 4 studies, n= 125; moderate quality evidence), but this is not clinically meaningful and AFO was not superior than FES (MD 0.00m/s, 95% CI -0.06 to 0.05; 4 studies, n= 895; moderate heterogeneity I^2= 56%; moderate quality evidence).

Similarly, a review by Shahabi et al (2019)*[199]* with 14 studies (n= 1186) found similar effects for AFO and FES (SMD 0.00, 95% CI -0.16 to 0.16; 8 studies, n= 962; poor to fair quality).

A review by Veldama et al (2019)*[110]* explored ergometer training with 28 studies (n= 1115). Ergometer training was effective in improving walking ability compared to no intervention (d=0.94, 95% CI 0.31 to 1.57; 7 studies, n= 317; high heterogeneity I^2= 97%). When compared to other interventions, ergometer training has no significant effects on walking ability (d= -0.13, 95% CI -0.66 to 0.37; 14 studies, n=664) and health-related quality of life (d=0.17, 95% CI -0.34 to 0.68). Six trials verified the effects of simple ergometer training, in comparison to ergometer training with the assistance of neuromuscular functional electrical stimulation (FES) in stroke rehabilitation (n= 191) and found no significant effects for walking ability (d=0.18, 95% CI -0.54 to 0.89), but high-intensity ergometer training causes significantly greater improvement of walking ability (d= 0.25; 95% CI, -0.68 to 1.17; I^2= 76%).

Kwong et al (2018)*[208]* explored the effectiveness of TENS at improving lower extremity motor recovery. Eleven studies and 439 participants were included. TENS improved walking capacity (g= 0.392, 95% CI 0.178 to 0.606; 9 studies, n= 329) when compared to placebo or no treatment groups, as measured by either gait speed or the Timed Up and Go test. Additionally, the review investigated the optimal stimulation parameters for TENS and observed significant effects in sessions of 60 minutes (g= 0.468, 95% CI 0.201 to 0.734; 5 studies, n= 216) but not in studies with shorter sessions (g= 0.254, 95% CI -0.106 to 0.614; 4 studies, n=113).

A review by Lin et al (2018)*[207]* investigated the influence of transcutaneous electric nerve stimulation (TENS). Seven studies and 214 participants were included. TENS increased walking speed (SMD 0.44, 95% CI 0.05 to 0.84; 3 studies, n= 52) when compared to placebo, but did not improve the Timed Up and Go Test (SMD -0.60, 95% CI -1.22 to 0.03; 2 studies, n= 34).

A narrative review by Schroder et al (2018)*[211]* investigated peripheral somatosensory stimulation (PSS) with 19 studies (n= 691). Majority received sensory-amplitude electrical stimulation (SES) (n= 479) and 91 participants received local vibration. Locomotor control of gait was observed to improve during SES which is similar to those effects seen during local vibration (1 study). A study investigated isolated local vibration added to usual care and found improved gait. However, repetitive application of isolated SES (e.g. TENS) led to neutral effects on gait ability in four studies and only a small improvement in the TUG compared to no stimulation in one study.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control (walking training alone)	**Intervention** Electrical stimulation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Walking speed	Measured by: Walking speed (m/s) High better Based on data from 203 participants in 8 studies. (Randomized controlled) Follow up: 0 months - 24 months.	Difference:	**MD 0.08 higher** (CI 95% 0.02 higher — 0.15 higher)	Moderate [1]	FES significantly improves walking speed by a small amount (MD 0.08m/s).

1. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors (only in 50% of trials), resulting in potential for

detection bias. Missing intention-to-treat analysis in 84% of trials..

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Virtual reality
Comparator: Usual care

Summary

A review by Zhang et al (2021)*[412]* explored VR interventions with 87 studies and 3540 participants. VR improved walking ability through the outcome of TUG (MD -2.1, 95% CI -3.52 to -0.73; 17 studies, n= 457; moderate heterogeneity I^2= 64%). However, no difference between groups was found for 10MWT (MD -1.45, 95% CI -6.89 to 3.98; 4 studies, n= 138). The velocity of the VR group improved more compared to the control group (MD 11.79, 95% CI 8.48 to 15.11; 9 studies, n= 310). The VR group had improved cadence to a better extent compared to the control group (MD 8.35, 95% CI 4.54 to 12.16; 9 studies, n= 262).

The updated Cochrane review by Laver et al (2017)*[230]* found no difference in gait speed with virtual reality therapy compared to same dose conventional therapy (MD 0.09, 95%CI -0.04 to 0.22; 6 studies, n=139; low quality evidence) and similarly no difference in gait speed comparing virtual reality plus usual care to usual care alone (MD 0.08, 95%CI -0.05 to 0.21; 3 studies, n=57; low quality evidence).

A review by de Rooij et al (2016)*[205]* investigated virtual reality (VR) with twenty-one studies with a median PEDro score of 6. VR training improved gait speed (SMD 1.03, 95% CI 0.38 to 1.69; 8 studies, n= 214; moderate heterogeneity I^2= 78%) and TUG (MD 2.48, 95% CI 1.28 to 3.67; 6 studies, n= 132; moderate heterogeneity I^2= 85%) significantly more than conventional therapy. The effect was sustained even after removing two studies affecting heterogeneity due to the magnitude of effect for both gait speed (SMD 0.86, 95% CI 0.52 to 1.20; 6 studies, n= 147) and TUG (MD 1.35, 95% CI 1.02 to 1.67; 4 studies, n= 93).

Ferreira et al (2018)*[206]* conducted a review on interactive video gaming with eleven studies (n= 310). Interactive video games did not improve mobility measured with the Timed Up and Go test (MD 0.51, 95% CI -2.66 to 1.64; 7 studies, n= 82).

Gibbons et al (2016)*[204]* explored the use of VR balance games with twenty two studies and 552 participants. VR did not improve functional mobility during the acute-subacute stage (WMD -10.94, 95% CI -26.00 to 4.11; 4 studies) or chronic stage (WMD -2.04, 95% CI -5.82 to 1.75; 6 studies), however, VR improved gait velocity for participants in the chronic phase (WMD 0.12, 95% CI 0.03 to 0.22; 7 studies, n= 160).

A systematic review by Corbetta et al (2015) *[178]* assessed the effects of virtual reality based rehabilitation as an addition to or substitute for standard rehabilitation. 15 trials with 341 total participants were included (7 trials and 138 participants for the outcome of walking speed). Virtual reality interventions that replaced some or all standard rehabilitation time led to significantly increased walking speed (MD 0.15 m/s, 95% CI 0.10 to 0.19). Only one small trial assessed virtual reality training as an addition to standard rehabilitation, meaning there was insufficient evidence to assess the benefits on walking speed.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Virtual reality	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Walking ability Immediately after intervention	Measured by: TUG High better Based on data from 457 participants in 17 studies. [1] (Randomized	Difference:	**MD 2.1 lower** (CI 95% 3.52 lower — 0.73 lower)	**Low**	Virtual reality probably improves walking ability (TUG).

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Virtual reality	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
7 Critical	controlled)				
Walking speed Immediately after intervention 7 Critical	Measured by: 10MWT High better Based on data from 138 participants in 4 studies. [2] (Randomized controlled)	Difference:	**MD 1.45 lower** (CI 95% 6.89 lower — 3.98 higher)	**Low**	Virtual reality probably improves walking speed (10MWT).
Functional Ambulation Category Immediately after intervention 9 Critical	Measured by: Functional Ambulation Category High better Based on data from 260 participants in 5 studies. [3] (Randomized controlled)	Difference:	**MD 0.47 higher** (CI 95% 0.14 higher — 0.79 higher)	**Low** Due to serious risk of bias, Due to serious inconsistency [4]	Virtual reality may improve functional ambulation category

1. Systematic review [412] . **Baseline/comparator:** Control arm of reference used for intervention.
2. Systematic review [412] . **Baseline/comparator:** Control arm of reference used for intervention.
3. Systematic review. **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [412],
4. **Risk of Bias: serious. Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:75%..

Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Cueing of cadence
Comparator: Control (walking training alone)

Summary

Nascimento et al (2015) *[176]* conducted a systematic review of walking training interventions with cueing of cadence, including 7 trials with 211 participants. Meta-analysis showed that the interventions with cueing of cadence significantly improved walking speed by 0.23 m/s (95% CI 0.18 to 0.27). However, there was substantial heterogeneity, and an analysis that excluded one trial with a much larger effect size showed a smaller but still significant improvement. There was also a high risk of bias in the majority of included trials.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control (walking training alone)	**Intervention** Cueing of cadence	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Walking speed	Measured by: Gait speed m/s	Difference:	**MD 0.23 higher** (CI 95% 0.18	**Low** Due to serious	Cueing of cadence does appear to significantly

Outcome Timeframe	**Study results and measurements**	**Comparator** Control (walking training alone)	**Intervention** Cueing of cadence	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
	High better Based on data from 171 participants in 6 studies. (Randomized controlled) Follow up: 2 weeks - 6 weeks.		higher — 0.27 higher)	risk of bias [1]	improve walking speed, however due to serious risk of bias in the majority of the trials this should be interpreted with caution.

1. **Risk of Bias: serious.** Majority did not report concealed allocation and did not have blinded assessors resulting in potential for detection bias, Missing intention-to-treat analysis. Majority had more than a 15% drop out rate..

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Joint position feedback
Comparator: Placebo or usual therapy

Summary

An update of a previous systematic review of randomised trials of biofeedback by Stanton et al (2017)*[155]* included 18 studies (n=429). Unlike the previous review (Stanton et al 2011 *[144]*) only studies with higher quality (PEDro score >4/10) were included hence there were slightly less studies overall (18 vs 22). Biofeedback interventions used in the trials included giving visual or auditory feedback on ground reaction force using a force platform or foot sensor (14 studies), visual or auditory feedback on muscle activity using EMG (three studies), and joint position via an electrogoniometer (1 study). Visual feedback was used in seven trials; auditory in seven trials; and a combination of both in four trials. The mean duration of intervention sessions was 33 minutes (SD 17), occurring with a mean frequency of 3.7 days per week (SD 1.6), and a mean duration of 5.2 weeks (SD 2.2). Control groups mostly received usual therapy (presumably with therapist communication as feedback) and amount of practice was matched between intervention and control. The mean time after stroke ranged from < 1 month to 10 years, with 53% of the trials carried out <6 months after stroke. Outcomes included measures of walking, standing balance and standing up. Pooling 17 studies (n=417) showed that lower limb activities (various standing and balance measures) were significantly improved following biofeedback (SMD 0.50, 95% CI 0.30 to 0.70).

Outcome Timeframe	**Study results and measurements**	**Comparator** Placebo or usual therapy	**Intervention** Joint position feedback	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Lower limb activity measures [1] Post-intervention (3 to 8 weeks treatment)	Measured by: Various measures e.g. functional reach, Berg Balance Scale, walking speed, step/stride length High better Based on data from 417 participants in 17 studies. [2] (Randomized controlled) Follow up: 2-8 weeks.	Difference:	**SMD 0.5 higher** (CI 95% 0.3 higher — 0.7 higher)	**Moderate** Due to risk of bias [3]	Biofeedback (various modes) improves lower limb activity measures (including walking speed, stride length, base of support, step length etc)

1. Various measures e.g. functional reach, Berg Balance Scale, walking speed, step/stride length
2. Systematic review [155] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Weak recommendation

Updated evidence, no change in recommendation

For stroke survivors, individually fitted lower limb orthoses may be used to minimise limitations in walking ability. Improvement in walking will only occur while the orthosis is being worn. (Daryabor et al. (2021)*[449]*; Wada et al. 2021*[448]*)

Practical Info

The type of orthosis worn should be prescribed following a thorough analysis of a person's walking. They should be custom fitted to suit the patient and address the walking deficits identified during gait analysis.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

The evidence supports the wearing of an orthosis (KAFO or AFO pooled in data analysis) to improve walking ability and gait speed by a small amount after stroke (Tyson et al. 2013 *[181]* ; Wada et al. 2021 *[448]*). No harms were reported (Tyson et al. 2013 *[181]* ; Wada et al. 2021 *[448]*).

Certainty of the Evidence

Moderate

The certainty of the effect estimates was low to moderate (Tyson et al. 2013 *[181]* ; Wada et al. 2021 *[448]*).

Values and preferences

Substantial variability is expected or uncertain

There may be some variation in patients' preferences due to the discomfort with orthosis and small scale of benefits.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

The evidence profile supports the wearing of lower limb orthoses to improve walking speed and walking ability. The data pooled studies which investigated the use of knee ankle foot orthoses (KAFO) and ankle foot orthoses (AFO), so when recommending their use, this should be reflected. In order to do this, the general term "orthoses" was used in place of "knee ankle foot orthoses" and "ankle foot orthoses". The evidence still supports them being custom fitted. Inclusion criteria in the 13 included trials was very broad, with only one trial specifying patients who had no ankle control and another two trials that specified marked ankle spasticity (Tyson et al. 2013 *[181]*).

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Orthosis
Comparator: No orthosis

Summary

Wada et al. (2021)*[448]* conducted a review with 14 studies (n= 282) investigating AFO. One RCT and 13 randomised crossover trials were included. Meta-analysis showed an improvement in walking speed (MD 0.09, 95% CI 0.06 to 0.12; 14 studies, n= 282; moderate heterogeneity I2= 57%; low certainty of evidence).

Choo and Chang (2021)*[447]* conducted a review with 19 studies (n= 434) exploring AFO for walking speed. Meta-analysis showed significant improvements in walking speed (SMD 0.50, 95% CI 0.34 to 0.66; 13 studies, n= 253) and walking ability (SMD 1.61, 95% CI 1.19 to 2.02; 3 studies, n= 61) when wearing AFOs. The studies had subjects with varying experience using AFO, from not wearing it before the study to wearing AFO daily for at least 6 months before the study.

Daryabor et al. (2021)*[449]* conducted a review with 30 mixed method studies (n= 669) investigating ankle-foot orthoses (AFO) compared with without AFO. A significant improvement was observed for walking ability (Functional Ambulatory Classification[FAC]; SMD 1.72, CI 1.25 to 2.19; 14 groups from 8 studies, n= 211; high heterogeneity I2=78.0%) and walking endurance (6MWT; SMD 0.91, 95% CI 0.53 to 1.28; 4 studies, n= 71). Results remained consistent across subgroups related to time since stroke, AFO type and quality of trials (for FAC).

Shahabi et al (2020)*[199]* conducted a review with 14 studies (n= 1186) exploring AFO for walking speed. When comparing AFO and without AFO, no significant improvement was found (SMD 0.41, 95% CI -0.15 to 0.96; 4 studies, n= 89). Similar effects were found for AFO and FES (SMD 0.00, 95% CI -0.16 to 0.16; 8 studies, n= 962) and when AFO was compared to another type of AFO no difference was found (SMD 0.22, 95% CI -0.05 to 0.49, n= 242).

Nascimento et al (2020)*[193]* explored AFO and functional electrical stimulation (FES) including 11 studies (n=1135 participants). Walking speed significantly increased when compared to no intervention/placebo for AFO (MS 0.24m/s, 95% CI 0.06 to 0.41; 2 studies, n= 61; moderate quality evidence), and AFO was not superior than FES (MD 0.00m/s, 95% CI -0.06 to 0.05; 4 studies, n= 895; moderate heterogeneity I^2= 56%; moderate quality evidence).

Tyson et al (2013) *[181]* conducted a review of ankle-foot orthosis (AFO) and included 13 studies (n=334) . Meta-analysis showed significant improvements in walking activity, walking speed and walking impairment, but a non-significant improvement on timed mobility measures. The small trials included in the study may have been underpowered and generally trials only assessed short-term effects of treatment, meaning long-term benefits are uncertain.

A Cochrane review conducted by Mendes et al (2020)*[201]* investigated the effect of motor neuroprosthesis (MN) and included four trials and 831 participants who were more than three months post stroke. AFO use was more beneficial than MN on activities involving lower limbs such as walking speed until six months of device use (MD −0.05 m/s, 95% CI −0.10 to −0.00; 2 studies, n= 605; low quality evidence); however, this difference was no longer present in sensitivity analysis. MN was no more beneficial than AFO on activities involving limbs such as walking speed between 6 and 12 months of device use (MD 0.00m/s, 95% CI −0.05 to 0.05; 3 studies, n= 713; low certainty evidence), Timed Up and Go (MD 0.51 s, 95% CI −4.41 to 5.43; 2 studies, n= 692; moderate certainty evidence), and modified Emory Functional Ambulation Profile (MD 14.77 s, 95% CI −12.52 to 42.06; 2 studies, n= 605; low certainty evidence). There was no significant difference in walking speed when MN was delivered with surface or implantable electrodes (p = 0.09; I^2 =

65.1%). MN was no more beneficial than another assistive device for participation scales of HRQoL (SMD 0.26, 95% CI −0.22 to 0.74; 3 studies, n= 632 participants; moderate heterogeneity I^2 = 77%; very low certainty evidence) and exercise capacity (MD −9.03 m, 95% CI −26.87 to 8.81; 2 studies, n= 692; low-certainty evidence). MN did not increase the number of serious adverse events related to intervention (RR 0.35, 95% CI 0.04 to 3.33; 2 studies, n= 692; low certainty evidence) or number of falls (RR 1.20, 95% CI 0.92 to 1.55; 3 studies, n= 802 participants; moderate-certainty evidence). However, the use of MN in people after stroke may increase the risk of participant dropping out during the intervention (RR 1.48, 95% CI 1.11 to 1.97; 4 studies, n= 829).

Outcome Timeframe	**Study results and measurements**	**Comparator** No orthosis	**Intervention** Orthosis	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Walking ability Immediately after intervention	Measured by: Functional Ambulation Categories High better Based on data from 244 participants in 8 studies. [1] (Randomized controlled) Follow up: 1 day.	Difference:	**SMD 1.72 higher** (CI 95% 1.25 higher — 2.19 higher)	**Low** Due to serious inconsistency, Due to serious risk of bias [2]	The use of an orthosis probably improves walking ability.
Walking speed Immediately after intervention 7 Critical	Measured by: Walking speed (m/sec) High better Based on data from 282 participants in 14 studies. [3] (Randomized controlled) Follow up: 1 day.	Difference:	**MD 0.09 higher** (CI 95% 0.06 higher — 0.12 higher)	**Low** Due to serious risk of bias, Due to serious inconsistency [4]	The use of an orthosis probably improves walking speed by a small amount.

1. Systematic review [449] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2: 78%..
3. Systematic review [448] . **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Incomplete data and/or large loss to follow up, Selective outcome reporting. **Inconsistency: serious.** The magnitude of statistical heterogeneity was moderate, with I^2:57 %..

Attached Images

Arm activity

Seventy-two percent of acute stroke patients have upper limb impairment on admission (Stroke Foundation 2020 *[8]*). Recovery of upper limb function plays an important role in activities of daily living. The term 'arm' function describes proximal upper limb (UL) function (i.e. shoulder/elbow), whereas 'hand' function describes distal UL function and coordination (i.e. wrist, hand, and fingers).

Some interventions target people with weak arm function (e.g. external supports, taping, electrical stimulation). Other interventions target people with weak or absent hand function (e.g. orthotics, mirror therapy, electrical stimulation), or with some active wrist and

finger movement (e.g. constraint-induced movement therapy). Some of the recommendations highlight interventions that are suitable for these subgroups.

Task-specific motor training forms the basis of the motor retraining that occurs as part of other interventions such as constraint-induced movement therapy. There is also direct evidence for task-specific training specifically (French et al. 2016 *[232]*).

Interventions which target activities of daily living such as eating, drinking and self-care and also involve the upper limb should also be considered here (see Activities of daily living). This section should also be read in conjunction with Weakness, Loss of sensation and Commencement of rehabilitation.

Strong recommendation

For stroke survivors with some active wrist and finger extension, intensive constraint-induced movement therapy (minimum 2 hours of active therapy per day for 2 weeks, plus restraint for at least 6 hours a day) should be provided to improve arm and hand use. (Corbetta et al. 2015 *[236]*)

Information previously included on trunk restraint during therapy has been moved to the practical info tab.

Practical Info

In most studies, participants had some active wrist and finger extension, no significant pain, spasticity or reduced range of joint motion, no or minimal cognitive deficits, no difficulties balancing during walking, and reduced use of the arm in everyday life.

Most studies included at least 2 weeks of:
(a) intensive, supervised task practice with the affected hand for 2 to 5 hours per day, 5 days per week,
(b) a transfer package and homework tasks, and
(c) restraint of the ***unaffected*** hand in a mitt or sling for at least 6 hours a day.

Many more trials included community-dwelling chronic stroke participants, with fewer trials conducted in the early acute inpatient phase. Active, intensive task practice is the key component to constraint-induced movement therapy, although the optimal timing and amount of practice remains unclear (Kwakkel et al. 2015 *[240]*). There is no evidence for the use of restraint alone (Kwakkel et al. 2015 *[240]*). Likewise trunk restraint may also be incorporated into the active therapy sessions to achieve greater focus on task-specific practice (Zhang et al 2020 *[245]*; Wee et al. 2014 *[229]*). Constraint-induced movement therapy is only relevant for people with no or minimal cognitive deficits.

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

There are no harms associated with constraint-induced movement therapy (CIMT). There is evidence that CIMT is effective in improving motor function and motor impairment, but no evidence that this reduces disability (Corbetta et al. 2015 *[236]*).

Certainty of the Evidence

Moderate

There is evidence from a large number of randomised controlled trials supporting use of CIMT for addressing motor impairment and motor function, with limited effect on disability.

Values and preferences

Substantial variability is expected or uncertain

The demands and expectation of patients during a CIMT program should be negotiated with stroke survivors and their family. Some people may not be willing or able to engage in 2 weeks of intensive practice, for up to 5 hours per day, plus doing daily homework tasks. Most people do not object to wearing the restraint during therapy sessions, but may object to wearing the restraint in the community.

Resources and other considerations

No important issues with the recommended alternative

Implementation considerations

There is a clinical indicator collected in the National Stroke Audit on the type of management provided to those patients who have difficulty using their upper limbs, including the provision of constraint-induced movement therapy.

Rationale

A Cochrane review of 42 trials (1453 participants) found that constraint-induced movement therapy (CIMT) was effective at improving arm function, dexterity (hand function), arm motor impairment and use of the arm in everyday life (Corbetta et al. 2015 *[236]*). However, there was no significant effect on disability (ability to perform activities of daily living) either immediately after treatment or at follow-up (Corbetta et al. 2015 *[236]*).

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Constraint-induced movement therapy for upper extremities
Comparator: Control

Summary

Corbetta et al (2015) *[236]* is the most recent Cochrane review of the effects of CIMT in stroke survivors with upper limb paresis. The participants had some residual motor power of the paretic arm and the potential for further motor recovery with limted pain and spasticity, but tended to use the affected limb little. The primary outcome was disability, in which there was a non-significant standard mean difference favouring CIMT over conventional treatment. A small but statistically significant improvement was seen in arm motor function. Data on the long-term effects of CIMT is scarce.

Etoom et al (2016)*[263]* identified 38 studies and pooled 36 studies (n=1473). Arm function was measured at level of impairment (e.g. Fugl-Meyer Assessment) or activity (Wolf Motor Function Test, Action Research Arm Test, Motor Activity Log). Overall there was a moderate effect size (SMD 0.56, 95%CI 0.30 to 0.81; high heterogeneity I^2=79.8%).

Liu et al (2017)*[252]* included 16 trials in acute and sub-acute phase. Pooling 6 studies resulted in significant improvement in the Action Research Arm Test (MD 8.35, 95%CI 1.98 to 14.71; extremely high heterogeneity I^2=94.1%). Motor Activity Log quality of movement was also significantly higher (MD 0.81, 95%CI 0.33 to 1.29; 4 studies; moderate heterogeneity I^2=56.7%).

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Constraint-induced movement therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Arm Motor Function - Constraint therapy versus no treatment Post intervention 8 Critical	Measured by: Various e.g. Wolf Motor Function Test, Action Research Arm Test, Motor Assessment Scale High better Based on data from 42 participants in 3 studies. [1] (Randomized controlled) Follow up: 2 to 10 weeks of treatment.	Difference:	**SMD 1.04 higher** (CI 95% 0.31 lower — 2.4 higher)	**Moderate** Due to serious risk of bias [2]	Constraint induced movement therapy probably improves arm motor function compared to no treatment
Perceived Arm Motor Function (Quality of Use) - CIMT versus	Measured by: Motor Activity Log High better Based on data from 865	Difference:	**MD 0.65 higher** (CI 95% 0.44 higher — 0.86 higher)	**High** [4]	Constraint induced movement therapy improves perceived arm motor function (quality

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Constraint-induced movement therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
usual care Post intervention	participants in 22 studies. [3] (Randomized controlled)				of use) compared to usual care
Perceived Arm Motor Function (Amount of Use) - CIMT versus usual care Post intervention 8 Critical	Measured by: Motor Activity Log High better Based on data from 818 participants in 21 studies. [5] (Randomized controlled) Follow up: 2 to 10 weeks of treatment.	Difference:	**MD 0.75 higher** (CI 95% 0.44 higher — 1.05 higher)	**Moderate** Due to serious inconsistency [6]	Constraint induced movement therapy probably improves perceived arm motor function (amount of use) compared to usual care
Quality of life - Constraint therapy versus usual care Post intervention 8 Critical	Measured by: Stroke Impact Scale High better Based on data from 96 participants in 3 studies. [7] (Randomized controlled)	Difference:	**MD 6.54 higher** (CI 95% 1.2 lower — 14.28 higher)	**High**	Constraint induced movement therapy has little or no difference on quality of life compared to usual care
Dexterity - Constraint therapy versus usual care Post intervention 8 Critical	Measured by: Various e.g. Grooved Pegboard Test, Nine-Hole Peg Test, Box and block test High better Based on data from 113 participants in 4 studies. [8] (Randomized controlled) Follow up: 2 to 10 weeks of treatment.	Difference:	**SMD 0.42 higher** (CI 95% 0.04 higher — 0.79 higher)	**High**	Constraint induced movement therapy improves dexterity compared to usual care
Disability Post intervention 9 Critical	Measured by: Functional Independence Measure and Barthel Index High better Based on data from 344 participants in 11 studies. (Randomized controlled) Follow up: 2 to 10 weeks of treatment.	Difference:	**SMD 0.24 higher** (CI 95% 0.05 lower — 0.52 higher)	**Moderate** Due to serious risk of bias [9]	Constraint-induced movement therapy probably has little or no difference on disability post-intervention
Disability 3 to 6 month follow-up 9 Critical	Measured by: Functional Independence Measure and Barthel Index High better Based on data from 125 participants in 3 studies. (Randomized controlled) Follow up: 3 to 6 months.	Difference:	**SMD 0.21 lower** (CI 95% 0.57 lower — 0.16 higher)	**Moderate** Due to serious risk of bias [10]	Constraint-induced movement therapy probably has little or no difference on disability at 3 to 6 month follow-up

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Constraint-induced movement therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Arm Motor Function - Constraint therapy versus usual care Post intervention 8 Critical	Measured by: Various e.g. Wolf Motor Function Test, Action Research Arm Test, Motor Assessment Scale High better Based on data from 816 participants in 25 studies. [11] (Randomized controlled) Follow up: 2 to 10 weeks of treatment.	Difference:	**SMD 0.31 higher** (CI 95% 0.09 higher — 0.52 higher)	**Low** Due to serious risk of bias, Due to serious inconsistency [12]	Constraint induced movement therapy may improve arm motor function compared to usual care

1. Systematic review [236] with included studies: Wittenberg 2003, Taub 1993, Kim 2008. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Missing intention-to-treat analysis in of included paper. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. Systematic review [236] with included studies: Brunner 2012, Lin 2009a, Boake 2007, Wu 2007b, Wu 2011, Wu 2007c, Wu 2012a, Lin 2010, Van Delden 2013, Dahl 2008, Myint 2008, Tariah 2010, Krawczyk 2012, Khan 2011, Hammer 2009, Wu 2007a, Huseyinsinoglu 2012, Smania 2012, Page 2005b, Wolf 2006, Lin 2007, Brogårdh 2009. **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: no serious.** risk of bias high in 4 of the 22 studies. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
5. Systematic review [236] with included studies: Wu 2007c, Smania 2012, Wu 2012a, Lin 2009a, Wu 2011, Lin 2007, Tariah 2010, Khan 2011, Brunner 2012, Van Delden 2013, Brogårdh 2009, Boake 2007, Hammer 2009, Wu 2007a, Wolf 2006, Myint 2008, Page 2005b, Wu 2007b, Dahl 2008, Huseyinsinoglu 2012, Lin 2010. **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: no serious.** 4 included studies had serious risk of bias. **Inconsistency: serious.** The confidence interval of some of the studies do not overlap with those of most included studies/ the point estimate of some of the included studies.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
7. Systematic review [236] with included studies: Lin 2009a, Dahl 2008, Wu 2007c. **Baseline/comparator:** Control arm of reference used for intervention.
8. Systematic review [236] with included studies: Hammer 2009, Brunner 2012, Van Delden 2013, Yoon 2014. **Baseline/comparator:** Control arm of reference used for intervention.
9. **Risk of Bias: serious.** 3 of 11 included studies had high risk of bias. **Inconsistency: no serious.** The magnitude of statistical heterogeneity was moderate, with I^2:47 %.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
10. **Risk of Bias: serious.** high risk of bias in 1 of the 3 included studies. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
11. Systematic review [236] with included studies: Dromerick 2000, Brogårdh 2009, Wu 2012a, Dromerick 2009, Wang 2011, Khan 2011, Van Delden 2013, Smania 2012, Brunner 2012, Wolf 2006, Hammer 2009, Atteya 2004, Page 2005b, Treger 2012, Ploughman 2004, Yoon 2014, Dahl 2008, Myint 2008, Page 2008, Huseyinsinoglu 2012, Bergheim 2010, Page 2001, Wu 2011, Hayner 2010, Tariah 2010. **Baseline/comparator:** Control arm of reference used for intervention.
12. **Risk of Bias: serious.** There was serious risk of bias in 7 of the included studies. **Inconsistency: serious.** The confidence interval of some of the studies do not overlap with those of most included studies/ the point estimate of some of the included studies.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Weak recommendation

For stroke survivors with at least some voluntary movement of the arm and hand, repetitive task-specific training may be used to improve arm and hand function. (French et al. 2016 *[232]*)

Practical Info

The optimal delivery methods and intensity (numbers of repetitions) for task-specific training remains unclear.

Trunk restraint in addition to task-specific practice may be useful to focus practice efforts in the early (<6 months) stages of recovery (Zhang et al 2020 *[245]*).

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

A Cochrane review by French et al. (2016 *[232]*) found small but consistent benefits for repetitive task-specific training for improving arm and hand function. Few adverse events have been reported.

Certainty of the Evidence

Low

Overall the quality of the evidence in the primary studies was low to moderate.

Values and preferences

No substantial variability expected

People with stroke are likely to want to engage in active therapy to improve motor function.

Resources and other considerations

No important issues with the recommended alternative

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

A ~~recent~~ Cochrane review (French et al. 2016 *[232]*) included between 8 and 11 studies (n = 619 to 749) that investigated the effectiveness of repetitive task-specific training on hand and arm function respectively. There were small but statistically significant positive effects for up to 6 months post-intervention.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Practice with trunk restraint
Comparator: Practice without trunk restraint

Summary

Zhang et al (2020)*[245]* identified 10 studies. Pooling nine studies (n = 255) which involved trunk restraint added to task training improved Motor Activity Log (amount MD 0.39, 95% CI 0.25 to 0.54; and quality of movement MD 0.45, 95%CI, 0.27 to 0.63; six studies, n=143), improved scores on the Actional Research Arm test (MD 4.51, 95%CI 2.49 to 6.54; 3 trials, n=81) and improved ADL (SMD 0.98, 95%CI, 0.19 to 3.21; 5 studies, n=163). Subgroup analysis found trials in subacute stage improved outcomes whereas, trials in chronic phase (>6months) had no significnant benefits.

Wee et al (2014) *[229]* included 6 randomised trials (n=187). All trials were rated 6 or higher on the PEDro scale. Three trials used trunk restraint as part of a constraint-induced movement therapy (CIMT) approach. Meta-analysis showed

significant improvements in Fugl-Meyer Upper Extremity scores (SMD 0.54, 95% CI 0.06 to 1.01) and shoulder flexion (SMD 0.45, 95% CI 0.11 to 0.79), with non-significant effects for elbow flexion and hand function. The trials appeared to be at high risk of bias, with a lack of clear sequence generation and allocation concealment. CIMT interventions also involved substantially more treatment hours than the other approaches, which may have contributed to the improved outcomes, rather than the trunk restraint approach alone.

Overall controlling trunk to focus on isolating arm practice should be considered alongside interventions for repetitive task practice.

Outcome Timeframe	**Study results and measurements**	**Comparator** Practice without trunk restraint	**Intervention** Practice with trunk restraint	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Arm function 7 Critical	Measured by: Action Research Arm Test High better Based on data from 81 participants in 3 studies. (Randomized controlled)	Difference:	**MD 4.51 higher** (CI 95% 2.49 higher — 6.54 higher)	**Low** Due to serious risk of bias from trials of low numbers [1]	Practice with trunk restraint may improve arm function
Self reported use (motor activity log amount of use) Post intervention 7 Critical	Measured by: Motor Activity Log - Amount of use High better Based on data from 143 participants in 6 studies. (Randomized controlled) Follow up: 1 day to 5 weeks of treatment.	Difference:	**MD 0.39 higher** (CI 95% 0.25 higher — 0.54 higher)	**Low** Due to serious risk of bias from trials of low numbers [2]	Practice with trunk restraint may increase self reported use (motor activity log amount of use)
Self reported use (motor activity log -quality of movement) Post intervention 7 Critical	Measured by: Motor Activity Log - Quality of movement High better Based on data from 143 participants in 6 studies. (Randomized controlled) Follow up: 1 day to 5 weeks of treatment.	Difference:	**MD 0.45 higher** (CI 95% 0.27 higher — 0.63 higher)	**Low** Due to serious risk of bias from trials of low numbers [3]	Practice with trunk restraint may increase self reported use (motor activity log quality of movement)

1. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients, Wide confidence intervals. **Publication bias: no serious.**
2. **Risk of Bias: serious. Inconsistency: no serious.** I2: 41%. **Indirectness: no serious. Imprecision: serious.** Low number of patients, Wide confidence intervals. **Publication bias: no serious.**
3. **Risk of Bias: serious. Inconsistency: no serious.** I2: 41%. **Indirectness: no serious. Imprecision: serious.** Low number of patients, Wide confidence intervals. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Task specific practice
Comparator: Control

Summary

A Cochrane systematic review by French et al. (2016) pooled results from interventions of repetitive task training *[232]*. There was low-quality evidence of improvement in arm and hand function. Effects remained statistically significant up to 6 months post intervention (SMD 0.92, 95% CI 0.58 - 1.26) but not between 6 to 12 months. There were few adverse events reported, however, lack of formal reporting in included studies means this finding is inconclusive. Treatment effects do not appear to be modified by duration of task practice, type of intervention, or time since stroke. On the other hand, the amount and heterogeneity of evidence did not allow for subgroup analysis of the optimal delivery methods, intensity (measured as numbers of repetitions), and patients' pre-intervention disability level.

da Silva et al (2020)*[246]* included 36 studies (n=814) involving task-specific practice plus stimulation priming via brain stimulation (17 studies), sensory priming (12 studies), movement priming (4 studies), or action observation priming (3 studies). All studies were >6months after stroke onset. Sensory priming increased scores for the Action Research Arm Test (MD 7.47, 95%CI 4.52 to 10.42; 2 studies, n=56). Other activity measures were mixed but all were based on very small patient/study numbers and further robust evidnece is needed.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Task specific practice	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Arm function end of treatment 7 Critical	Measured by: Various (ARAT, WMFT, MAS, BBT, FTHUE, SMGA) High better Based on data from 749 participants in 11 studies. [1] (Randomized controlled)	Difference:	**SMD 0.25 higher** (CI 95% 0.01 higher — 0.49 higher)	**Low** Due to serious risk of bias, Due to serious inconsistency [2]	Task specific practice may improve arm function
Hand function end of treatment 7 Critical	Measured by: Various (9HPT, 10HPT & MAS) High better Based on data from 619 participants in 8 studies. [3] (Randomized controlled)	Difference:	**SMD 0.25 higher** (CI 95% 0 higher — 0.51 higher)	**Low** Due to serious risk of bias, Due to serious inconsistency [4]	Task specific practice may improve hand function

1. Systematic review [232] with included studies: Blennerhassett 2004a, Turton 1990, Ross 2009, Salbach 2004b, Winstein 2004, Winstein 2016, Van Vliet 2005, Kwakkel 1999b, Langhammer 2000, Yen 2005, Arya 2012. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:58%.. **Indirectness: no serious. Imprecision: no serious.**
3. Systematic review [232] with included studies: Winstein 2016, Ross 2009, Salbach 2004b, Langhammer 2000, Blennerhassett 2004a, Turton 1990, Arya 2012, Van Vliet 2005. **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:54%.. **Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Weak recommendation

For stroke survivors with mild to severe arm weakness, mechanically assisted arm training (e.g. robotics) may be used to improve upper limb function. (Mehrholz et al. 2018 *[223]*)

Practical Info

The Cochrane review included studies using a range of different robotic devices (Mehrholz et al. 2018 *[223]*), therefore there is no evidence for one device being superior to another.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Mechanically assisted arm training improved arm impairment measures and activities of daily living. (Mehrholz et al. 2018 *[223]*) There was no difference on measures of arm activity (Veerbeek et al. 2017 *[256]*; Chieng et al. 2020 *[257]*). There are no reported harms associated with the interventions.

Certainty of the Evidence

High

Quality of the evidence is moderate to high.

Values and preferences

No substantial variability expected

Patients are unlikely to have strong preferences for or against the use of mechanically assisted arm training.

Resources and other considerations

Important issues, or potential issues not investigated

<u>Resources considerations</u>

Robotic devices may be expensive, although more services in Australia are purchasing a device for patient use. Private clinics exist in some states of Australia and offer a range of robotic devices for a fee.

There is evidence from recent studies that robotic therapy is less costly than conventional therapy in patients with severe impairment after stroke (Lo et al 2019*[241]*). Evidence has been provided from a systematic review, whereby the cost of robotic stroke rehabilitation for lower and upper limbs was compared to usual care in five studies (pooled sample size n=213) conducted in four different countries (Germany, Italy, Mexico and United States of America). In four studies, the cost per patient in the robotic therapy arm was more than 50% less when compared to conventional therapy. Robotic therapy was more cost saving in patients with severe stroke due to these patients requiring more one-on-one therapist time if receiving conventional therapy. Robotic therapy was less costly if more patients were treated in a given time period. However, variability in the therapy dosage, types of robotic devices used, therapist costs and small sample sizes were sources of uncertainty for the economic outcomes.

<u>Implementation considerations</u>

There is a clinical indicator collected in the National Stroke Audit on the type of management provided to those patients who have difficulty using their upper limbs, including the provision of mechanically assisted training.

Rationale

A Cochrane review including 45 trials (Mehrholz et al. 2018 *[223]*) found evidence that mechanically assisted arm training modestly improves arm impairmentand activities of daily living, particularly when provided earlier (less than 3 months) after stroke. The strength of the evidence is moderate to high but there was variation in trial intensity, duration, and types of treatment used. Most studies matched the amount of scheduled therapy time in the control groups, but few matched for repetitions. Thus, it is likely that the benefits of mechanically assisted arm training come from more efficient use of therapy time to deliver a great number of repetitions of active practice.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Electromechanical and robot-assisted arm training
Comparator: All other interventions

Summary

A Cochrane review of electromechanical and robot-assisted arm training interventions included 45 trials with 1619 total participants (Mehrholz et al 2018 *[223]*). Meta-analysis showed significant improvements in activities of daily living (ADL) scores (SMD 0.31, 95% CI 0.09 to 0.52) as well as arm impairment and arm muscle strength. Effects were found for studies in acute and subacute phase (ADL SMD 0.4, 95%CI 0.1 to 0.7; 13 studies, n=523) but not during the chronic phase (ADL SMD 0.56, -0.23 to 1.35; 11 studies, n=425).

Veerbeek et al (2017)*[256]* identified 44 studies (n=1362) on robot-assisted therapy. Pooling 28 studies (n=884) found a very small improvement in arm impairment (Fugl-Meyer Assessment MD 2.62, 95%CI 1.48 to 3.76). No difference in measures of arm activity were found (SMD 0.04, 95%CI -0.12 to 0.19; 20 studies, n=682).

Chien et al (2020)*[257]* included 11 trials. No difference was found for measures of arm activity (SMD 0.01, 95%CI -0.28 to 0.3; 4 studies, n=219).

Chen et al (2020)*[258]* included 35 studies (n=2,241) of robot-assisted training. No significant improvement was found for measures of arm activity (SMD 0.109, 95%CI -0.07 to 0.28; moderate heterogeneity I2=54.6%; 26 studies, n=1557). Authors reported that robotic-assisted training was non-inferior to therapist led training based on pre-defined non-inferiority margins. This review included data from the RATULS trial (Rogers et al 2019 *[330]*) which compared robot-assisted training, enhanced functional training and usual care. There was no significant difference in arm activity between any of the groups at three months, however, the dose of therapy (45mins, 3 times per week for 12 weeks) is likely under the threshold needed to produce significant improvement.

A review by Wu et al 2021*[419]* explored robot-assisted therapy (RT) with 41 studies (n= 1916). RT significantly improved arm function with a small effect size of 0.25 (95% CI 0.11 to 0.38; 41 studies, n= 1,906) and specifically unilateral RT was superior to conventional therapy (Hedges g 0.32, 95% CI 0.15 to 0.50; moderate heterogeneity I^2= 55.9%; 31 studies, n= 1,548). No significant effect was found when comparing bilateral RT (Hedges g 0.07, 95% CI -0.15 to 0.28; 11 studies, n =312) or combined unilateral and bilateral RT (Hedges g= 0.22, 95% CI -0.71 to 1.15; 3 studies, n= 80; moderate heterogeneity I^2= 74.5%) with conventional treatment. End effector devices had a significant effect (Hedges g 0.22, 95% CI 0.09 to 0.36; 31 studies, n= 1,605) compared to conventional treatment, however, the effect exoskeleton had was not significant (Hedges g 0.31, 95% CI 0.31, 95% CI -0.14 to 0.76; 9 studies, n= 301).

Baniqued et al (2021)*[417]* reviewed brain-computer interface (BCI) robotics for hand rehabilitation with thirty studies. 19 out of the 30 studies on the BCI-robotic systems are at the prototype or pre-clinical stages of development. Due to the heterogeneity of outcomes reported, no meta-analysis was completed. Upper extremity function using the measure of Fugl-Meyer Motor Assessment Upper Extremity (FMA-UE, 2 studies, n=95) and arm function measured with the Action Research Arm Test (ARAT, 3 studies, n=88) improved compared to control for each of the studies that reported it.

Zhao et al (2022) reviewed 22 studies (n = 758) on the effects of robot-assisted training in distal upper limb function compared to standard treatment. Subgroup analysis found significant improvements in activities of daily living in the intervention (SMD =0.70; 95% CI: -0.29 to 1.11, 5 studies, n = 282) compared to the control group.

Outcome Timeframe	**Study results and measurements**	**Comparator** All other interventions	**Intervention** Electromechanical and robot-assisted training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Acceptability: drop-outs during intervention period During intervention	Relative risk 1 (CI 95% 0.98 — 1.03) Based on data from 1,619 participants in 45 studies. [1] (Randomized controlled) Follow up: 2 to 12 weeks of treatment.	**57** per 1000 Difference:	**56** per 1000 **1 fewer per 1000** (CI 95% 20 fewer — 20 more)	**Moderate** Due to serious risk of bias [2]	electromechanical and robotic assisted training has little or no difference on acceptability: drop-outs during intervention period

Outcome Timeframe	**Study results and measurements**	**Comparator** All other interventions	**Intervention** Electromechanical and robot-assisted training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Activities of daily living End of intervention phase	Measured by: Various, e.g. Barthel Index, Functional Independence Measure High better Based on data from 957 participants in 24 studies. [3] (Randomized controlled) Follow up: 2 to 12 weeks of treatment.	Difference:	**SMD 0.31 higher** (CI 95% 0.09 higher — 0.52 higher)	**High**	Electromechanical and robot-assisted training slightly improves activities of daily living
Arm impairment End of intervention phase	Measured by: Fugl-Meyer score High better Based on data from 1,452 participants in 41 studies. [4] (Randomized controlled) Follow up: 2 to 12 weeks of treatment.	Difference:	**SMD 0.32 higher** (CI 95% 0.18 higher — 0.46 higher)	**High**	Electromechanical and robot-assisted training slightly improves arm impairment

1. Systematic review [223] with included studies: Masiero 2011, Sale 2014, Hwang 2012, Daly 2005, Hsieh 2014, Burgar 2011, Lo 2010, Brokaw 2014, Fazekas 2007, Abdullah 2011, Lum 2006, Yoo 2013, Masiero 2007, Klamroth-Marganska 2014, Kahn 2006, Conroy 2011, Volpe 2008, Rabadi 2008, Hollenstein 2011, Ang 2014, Lum 2002, Susanto 2015, Timmermans 2014, Kutner 2010, Amirabdollahian 2007, Hesse 2005, Housman 2009, Liao 2011, Hsieh 2011, Mayr 2008, Hesse 2014, Wu 2012, Volpe 2000, McCabe 2015. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** A number of ratings with high risk of bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. Systematic review [223] with included studies: Burgar 2011, Wu 2012, Yoo 2013, Fazekas 2007, Masiero 2007, Hesse 2005, Housman 2009, Volpe 2000, Kutner 2010, Liao 2011, Volpe 2008, Hsieh 2011, Lo 2010, Hesse 2014, Rabadi 2008, Lum 2006, Conroy 2011, Masiero 2011. **Baseline/comparator:** Control arm of reference used for intervention.
4. Systematic review [223] . **Baseline/comparator:** Control arm of reference used for intervention.

Attached Images

Weak recommendation

Virtual reality and interactive games may be used to improve upper limb function. (Laver et al. 2017 *[283]*; Aminov et al. 2018 *[262]*)

Practical Info

There appears to be no difference in outcome between trials that have used commercially available equipment compared to more expensive custom-made systems although some reviews have conflicting results. Some people may not be able to tolerate virtual reality, and it may not be appropriate for people with cognitive or visual deficits. The benefits of virtual reality training appear to be related to the 'dosage' (amount) of active therapy delivered.

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

There is a clear signal of benefit for virtual reality and interactive video gaming to improve arm function and activities of daily living when used as an adjunct to usual care (to increase overall therapy time) or when compared with the same dose of conventional therapy to improve activities of daily living (Laver et al. 2017 *[283]*). There were few reported adverse events and those that were reported were mild (Laver et al. 2017 *[283]*).

Certainty of the Evidence

Low

Most outcomes were rated as low or moderate certainty.

Values and preferences

Substantial variability is expected or uncertain

Patients are unlikeley to have strong preferences for the use of virtual reality.

Resources and other considerations

No important issues with the recommended alternative

Cost savings from providing upper limb therapy after stroke via virtual reality training instead of conventional training were explored in a study conducted in Denmark, Norway and Belgium (Islam et al 2019). In this study, 120 patients within 3 months of experiencing stroke were randomized to virtual reality training or conventional training for upper limb rehabilitation. There were no cost savings from using virtual reality training under trial circumstances since both approaches required identical therapist time. Different scenarios were modelled in simulations by the researchers. Assuming virtual reality training required only 25% of the therapist's normal time in supervising the training, there was an estimated cost saving of $9,023 (US, 2016). Only the costs of providing the rehabilitation were considered and no impacts on treatment effectiveness from reduced therapist supervision time were explored. Further research is required to determine if upper limb therapy via virtual reality training is cost-effective compared to conventional therapy.

Rationale

The updated Cochrane review (Laver et al. 2017 *[283]*) found a significant effect for virtual reality and interactive video gaming to improve arm function and activities of daily living when used as an adjunct to usual care (to increase overall therapy time). There was no difference in arm function when virtual reality was compared to the same dose of conventional therapy but there was a small increase in activities of daily living. Unlike the previous version subgroup analyses found no difference in outcomes for dose of treatment (less or greater than 15 hours) so this has been removed from the recommendation. Subgroup analysis also found no difference on level of impairment or time since stroke onset. Results are consistent with other systematic reviews (Aminov et al 2018 *[262]*; Karamians et al 2020 *[261]*).

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Virtual reality
Comparator: Conventional therapy

Summary

A Cochrane Review by Laver et al (2017) *[283]* found 10 studies (n=466) that measured ADL abilities within the 72 studies included in their review comparing virtual reality (VR) to conventional therapy. A small difference in ADL ability was found, favouring the intervention compared to same dose of conventional therapy (SMD 0.25) but in sensitivity analysis removing four studies at unclear or high risk of bias the results were smaller and non-significant (SMD 0.20, 95% CI -0.01 to 0.40).

However, when comparing the addition of VR plus routine therapy there was a moderate effect size (SMD 0.44, 95% CI 0.11 to 0.76; low certainty evidence) for improving ADL ability based on eight studies (n=153). Sensitivity analysis of

two trials deemed at low risk of bias found stronger effects but wider confidence intervals (SMD 0.92, 95% CI 0.04 to 1.81). . However, there was no evidence that effects were sustained long-term. This intervention is relatively safe.

Chen et al (2022) *[508]* reviewed 21 studies (n = 1,149) comparing the effects of virtual reality (VR) rehabilitation training to conventional treatment, in patients with poststroke cognitive impairment. VR rehabilitation significantly improved activities of daily living measured on Barthel Index (MD = 6.14, 95% CI: 4.56 to 7.72, 4 studies, n = 212) compared to control. VR rehabilitation also significantly improved activities of daily living measured by the modified Barthel Index (MD = 3.80, 95% CI: 1.55 to 6.06, 4 studies, n = 219) compared to the control. VR rehabilitation training may be a good addition to conventional cognitive interventions.

Leong et al (2022) *[513]* reviewed 50 studies (n = 2,271) exploring the use of virtual reality (VR), augmented reality (AR) and mixed reality (MR) technologies in upper limb rehabilitation and activities of daily living. Outcomes of activities of daily living were measured using the Functional Independence Measure (FIM). Subgroup analysis reported a significant improvement in activities of daily living (MD = 4.25, 95% CI: 1.47 to 7.03) compared to control group. High heterogeneity of included studies.

Zhang et al (2023) *[521]* reviewed 52 studies (n = 1,559) evaluating the effect of robot-assisted and virtual reality interventions on balance, gait and daily function. Subgroup analysis reported that the virtual reality intervention was most likely to be ranked as superior according to SUCRA (92%, MD= -7.85, 95% CI: -15.18 to -1.07). Virtual reality had a more significant improvement of modified Barthel Index compared to robot-assisted interventions (MD = 7.48, 95%CI: 0.26 to 16.42) and conventional therapy (MD = -7.85, 95% CI: -15.18 to -1.07).

Park et al (2021) *[525]* studied (n = 44) the effects of a glove-type wearable virtual reality device on upper limb function compared to conventional physical therapy. The intervention had a significant improvement in activities of daily living measured on modified Barthel index (change, M = 31.68 SD± 19.79) compared to the control group (change, M = 21.63 SD± 17.94).

Mugisha et al (2022) *[526]* reviewed 22 studies (n = 1,253) on the effects of either immersive or non-immersive virtual reality interventions, compared to conventional therapy. Subgroup analysis of immersive virtual reality interventions on upper limb function indicated a greater improvement in activities of daily living in the intervention group, with a moderate effect size (SMD = 0.54, 95% CI: 0.15 to 0.93,3 studies, n = 109) compared to the control.

Outcome Timeframe	**Study results and measurements**	**Comparator** Conventional therapy	**Intervention** Virtual reality	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
ADL [1] Post intervention 8 Critical	Measured by: Various e.g. Functional Independence Measure, Barthel Index High better Based on data from 466 participants in 10 studies. [2] (Randomized controlled)	Difference:	**SMD 0.25 higher** (CI 95% 0.06 higher — 0.43 higher)	**Moderate** Due to serious risk of bias in some studies [3]	Virtual reality probably improves ADL slightly

1. Measures of ADL, such as Barthel Index, Functional Independence Measure, and modified Rankin Scale
2. Systematic review [283] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious.** Risk of bias was unclear in a number of studies.. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** small total population size. **Publication bias: no serious.**

Attached Images

Weak recommendation

For stroke survivors with mild to severe arm or hand weakness, electrical stimulation in conjunction with motor training may be used to improve upper limb function. (Howlett et al. 2015 *[177]*; Yang et al. 2019 *[266]*)

Practical Info

Electrical stimulation should be provided in conjunction with motor training, ensuring enough dosage (amount) of practice is achieved. It is unclear whether electrical stimulation is more or less effective in people with different degrees of arm weakness.

Evidence To Decision

Benefits and harms — Substantial net benefits of the recommended alternative

There does not appear to be harm associated with electrical stimulation, and stimulation may be beneficial to upper limb activity recovery (Howlett et al. 2015 *[177]*).

Certainty of the Evidence — Moderate

The quality of the evidence is reasonable, although most studies had small sample sizes and did not include intention-to-treat analyses.

Values and preferences — Substantial variability is expected or uncertain

Patients are unlikely to have strong preferences in relation to electrical stimulation. Some patients may dislike or refuse the stimulation.

Resources and other considerations — Factor not considered

Rationale

When electrical stimulation is provided with the purpose of improving arm function and in conjunction with motor training, there is strong evidence that it improves arm function when compared to either motor training alone or no/placebo therapy. There is some conflicting evidence but electrical stimulation may also improve arm activity.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Electrical stimulation
Comparator: Usual care without stimulation

Summary

Electrical stimulation can be used passively (i.e. patients do not do any active exercises during therapy) or actively (combined with motor training). Passive electrical stimulation is more often used to treat or prevent shoulder subluxation or pain. (See the Subluxation and Shoulder pain topics in the Managing complications chapter). This section considers evidence for the use of electrical stimulation combined with active motor training with the intention of improving arm or hand function.

A systematic review by Howlett et al (2015) *[177]* included 18 trials in total (10 involving upper limb training), all of which included electrical stimulation with the intent to produce muscle contraction and in combination with motor training. Meta-analysis of upper-limb activity measures showed a large and significant benefit of electrical stimulation in addition to motor training when compared to either no therapy or motor training alone (SMD 0.69, 95% CI 0.33 to 1.05). When all 18 trials were considered together, there was a significant effect in favour of electrical stimulation plus

motor training improving activity (walking speed or arm activity) when compared to either motor training alone (SMD 0.56, 95% CI 0.21 to 0.92) or no therapy (SMD 0.40, 95% CI 0.08 to 0.72).

Monte-Silva et al (2019)*[255]* included 26 studies (n=782). EMG triggered/controlled neuromuscular electrical stimulation improved arm impairment but there was no evidence on measures of activity (SMD 0.20, 95%CI -0.03 to 0.42; 19 studies, n=562) or participation (SMD 0.44, -0.08 to 0.96; 6 studies, n=208).

Yang et al (2019)*[266]* included 59 studies of which 48 contributed to the meta-analysis comparing electrical stimulation to placebo/control. Studies were grouped into three types of electrical stimulation (sensory, cyclic, and EMG-triggered electrical stimulation). There was no difference found between these three types of intervention. Electrical stimulation had moderate to large effects both immediately after treatment and at follow up on arm activity (Action Research Arm Test post treatment SMD 0.70, 95%CI 0.39 to 1.02; 10 studies, n=411; moderate heterogeneity I^2=56%). At follow up SMD 0.93, 95%CI 0.34 to 1.52; 8 studies, n=289; high heterogeneity I^2=81%). But it appears the included studies were a mix of active and passive approaches.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care without stimulation	**Intervention** Electrical stimulation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Upper limb activity Post intervention 8 Critical	Measured by: Various motor function scales e..g Motor Assessment Scale, Arm Motor Ability Test, nine hole peg test, Action Research Arm Test, Box and Block test, Upper Extremity Function Test and Wolf Motor Function Test High better Based on data from 192 participants in 8 studies. (Randomized controlled) Follow up: 2 to 12 weeks of treatment.	Difference:	**SMD 0.69 higher** (CI 95% 0.33 higher — 1.05 higher)	**Low** Due to serious inconsistency, Due to serious imprecision, Due to serious risk of bias, Due to serious imprecision [1]	Electrical stimulation provided with motor training may improve upper limb activity

1. **Risk of Bias: serious.** 7 out of the 8 included studies missing intention-to-treat analysis, 3 out of 8 studies had Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious.** The point estimate of some of the included studies vary widely but, magnitude of statistical heterogeneity was low, with I^2: 27%.. **Indirectness: no serious.** Unable to differentiate effect for upper limb electrical stimulation plus motor training compared to either motor training alone or no training. . **Imprecision: serious.** Low number of patients in included trials. **Publication bias: no serious.**

Attached Images

Weak recommendation

For stroke survivors with mild to moderate weakness of their arm, mental practice in conjunction with active motor training may be used to improve arm function. (Barcley-Goddard et al. 2020 *[225]*; Borges et al. 2018 *[243]*)

Practical Info

Communication and cognitive abilities, including attention and working memory, are likely to impact on the feasibility and outcomes of mental practice.

Different mental practice strategies were used in the literature, but all involved visualisation of specific movements. The optimal 'dosage' (amount) of therapy and therapy schedule remains unclear, with the literature reporting a range of 10–60 minute therapy sessions performed ranging from daily to once a week for between 3 and 12 weeks.

For patients to use mental practice correctly, therapists will need to spend time teaching them 'how to do' the practice. Like meditation and mindfulness, mental practice requires focused attention, a quiet location and assistance from others to maintain the habit.

Similarly action observation requires assistance to set up the person to observe the activity either directly in person or via recording. Feedback on what to look for and steps to undertake before practice are needed and again the capacity of the patient to participate in the intervention needs to be considered.

Evidence To Decision

Benefits and harms — Small net benefit, or little difference between alternatives

Mental practice or similar strategies (e.g. action observation) appear to improve arm activity. (Barclay-Goddard et al. 2020 *[225]*; Borges et al. 2018 *[243]*). There are no reported harms.

Certainty of the Evidence — Moderate

Outcomes were rated as moderate certainty with some outcomes of low certainty.

Values and preferences — Substantial variability is expected or uncertain

Some patients will not be able or willing to learn how to do mental practice.

Resources and other considerations — Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

Several systematic reviews have shown consistent moderate effects for the use of mental imagery to improve arm activity. *[224]* Most studies have included participants with at least some voluntary arm movement, so the effect of mental practice on those with very severe weakness or very mild weakness is not known. Most studies used mental practice in conjunction with motor training. Action observation has a similar positive effect on arm function.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Mental practice in addition to other treatment
Comparator: Other treatment

Summary

Barclay-Goddard et al (2020)*[225]* included 25 studies (n=676). Pooling 15 studies (n=397) found mental practice in combination with other treatment improved arm activity compared to other treatment alone (SMD 0.66, 95%CI 0.39 to 0.94; moderate certainty of evidence). Similarly impairment level outcomes were improved (SMD 0.59, 95%CI 0.30 to 0.87; moderate certainty of evidence). Mental practice was not found to be different to conventional treatment on measures of arm impairment (SMD 0.34, 95% CI -0.33 to 1.00; 3 studies, n=50; low certainty evidence). Subgroup analyses of time post stroke, dosage, or comparison type for the mental practice in combination with other rehabilitation treatment showed no differences. No outcomes for economics or adverse events were found.

Another Cochrane review by Borges et al (2018)*[243]* included 12 studies (n=478) and found action observation improved measures of arm function (SMD 0.36, 95%CI 0.13 to 0.60; 8 studies, n=314; low-quality evidence), improved hand function (Box and Block test MD 2.90, 95% CI 1.13 to 4.66; 3 studies, n=132; moderate-quality evidence), and improved ADL (SMD 0.86, 95% CI 0.11 to 1.61; 4 studies, n=226; low-quality evidence).

Results are similar for other reviews. Stockley et al (2020)*[260]* included 15 trials (n=486) and pooled 12 studies (n=328) in analysis which found moderate improvements in measures of arm activity (SMD 0.60, 95%CI 0.32 to 0.88). Subgroup analysis suggested mental practice was most effective within first 3 months and for those with more severe arm deficits. Song et al (2019)*[242]* included 12 studies (n=268) and found improvement in Action Research Arm Test [ARAT] (MD 4.09, 95%CI 1.99 to 6.20) and impairment using the Fugl-Meyer assessment (MD 2.07, 95%CI 1.24 to 2.91). Guerra et al (2017)*[244]* found 21 studies related to arm activity and reported motor imagery improved ARAT scores (MD 4.80, 95%CI 2.47 to 7.13, four trials) and combined scores of motor function (SMD 0.36, 95%CI, 0.16 to 0.55; 11 studies). Kho et al (2014) *[224]*) found mental practice in addition to other therapy lead to improvement in arm function (MD 6.8 for Action Research Arm Test; 5 RCTs and 1 CCT). Braun et al (2013) *[180]* included 7 trials (197 participants) and found a favourable estimate of effect as measured by the Action Research Arm Test (SMD 0.62, 95% CI 0.05 to 1.19). Finally, Verbeek et al (2014) *[24]* included 14 randomised controlled trials (424 participants) and found a positive effect in favour of mental practice for improving arm function (Hedge's g 0.55, 95% CI 0.11 to 0.997).

Outcome Timeframe	**Study results and measurements**	**Comparator** Other treatment	**Intervention** Mental practice in addition to other treatment	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Arm activity measures End of treatment 7 Critical	Measured by: Action Research Arm Test or Arm Functional Test High better Based on data from 397 participants in 15 studies. [1] (Randomized controlled) Follow up: 3 to 12 weeks of treatment.	Difference:	**SMD 0.66 higher** (CI 95% 0.39 higher — 0.94 higher)	**Moderate** Due to serious risk of bias [2]	Mental practice in addition to other treatment probably improves arm activity

1. Systematic review [225] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Weak recommendation

For stroke survivors with mild to moderate weakness, mirror therapy may be used as an adjunct to routine therapy to improve arm function after stroke. (Thieme et al. 2018 *[227]*)

Practical Info

In the trials, mirror therapy was provided between 15 and 60 minutes for each session, three to seven times a week, for a period lasting between two to eight weeks (on average 30 minutes a session, five times a week, for four weeks). (Thieme et al 2018 *[227]*)

Based on the trials specific to upper limb included in the Cochrane review, mirror therapy protocols should consider:

- use of a large mirror rather than a small mirror
- that unilateral practice is better than bilateral execution
- that manipulation of objects during practice (compared to representation of body positions) did not lead to greater effect.

(Morkisch et al 2019 *[247]*)

Some stroke patients may find it difficult to focus their attention on the mirror and their practice. Other stroke patients and/or their carers may construct a mirror box at home and need instruction from therapists about which exercises to do.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

There are no reported adverse events associated with mirror therapy (Thieme et al. 2018 *[227]*). There is some evidence for a small effect of mirror therapy on improving arm function and abilities in activities of daily living (Thieme et al. 2018 *[227]*).

Certainty of the Evidence

High

Most trials included in the meta-analysis were of high quality.

Values and preferences

Substantial variability is expected or uncertain

Some stroke patients may find it difficult to focus their attention on the mirror and their practice.

Other stroke patients and/or their carers may construct a mirror box at home and need instruction from therapists about which exercises to do.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

A Cochrane review involved 31 trials specifically focused on arm function (Theime et al. 2018 *[227]*) and found moderate effects for mirror therapy improving measures of arm activity and ADL. There was no overall difference in effects when mirror therapy was used in people in the subacute orchronic stage post-stroke.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Mirror therapy for improving motor function after stroke
Comparator: All other interventions

Summary

A Cochrane review by Thieme et al 2018 *[227]*) Included 62 studies (n=1982) comparing mirror therapy with other interventions. Mirror therapy significantly improved arm motor function (SMD 0.46, 95%CI 0.23 to 0.69; 31 studies, n=1048; moderate certainty evidence). Mirror therapy also improved ADL (SMD 0.48, 95%CI 0.30 to 0.65; 28 studies, n=898; moderate certainty evidence).

Saavedra-Garcia et al (2021)*[259]* included 8 studies of which 7 (n=314) were pooled that compared mirror therapy plus electrical stimulation to conventional care or individual therapy. Results were mixed with no difference on arm motor fuction (using the Fugl-Meyer Assessment) or activity (Box and Block test) but there was improvements in Action Research Arm Test (MD 3.54, 95%CI 0.18 to 6.90). The quality of the evidence was rated as high overall by the authors.

Outcome Timeframe	**Study results and measurements**	**Comparator** All other interventions	**Intervention** Mirror therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Arm activity End of intervention 8 Critical	Measured by: Various (e.g. ARAT, WMFT, MAS, BBT) High better Based on data from 1,048 participants in 31 studies. [1] (Randomized controlled) Follow up: 2 to 6 weeks of treatment.	Difference:	**SMD 0.46 higher** (CI 95% 0.23 higher — 0.69 higher)	**Moderate** 2	Mirror therapy probably improves upper limb motor function
Activities of Daily Living End of intervention 8 Critical	Measured by: Functional Independence Measure, Barthel Index High better Based on data from 622 participants in 19 studies. (Randomized controlled) Follow up: 2 to 6 weeks of treatment.	Difference:	**SMD 0.48 higher** (CI 95% 0.3 higher — 0.65 higher)	**Moderate** 3	Mirror therapy probably improves activities of daily living

1. Systematic review [227] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Low number of patients. **Publication bias: no serious.**
3. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Strong recommendation against

Hand and wrist orthoses (splints) should not be used as part of routine practice as they have no effect on function, pain or range of movement. (Tyson et al. 2011 *[228]*)

Practical Info

Routine use of hand and wrist orthoses is not recommended for patients with no active wrist or finger extension. Alternative interventions which can be used include electrical stimulation and motor training for paralysed or weak muscles, and mirror therapy. Where therapists choose to prescribe a hand or wrist orthosis for individual patients on a case-by-case basis, objective measurements should be obtained before and after splinting to evaluate outcomes.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Use of wrist and hand orthoses have no effect on either range of motion of the wrist, or hand function (Tyson et al. 2011 *[228]*). Few adverse events were reported in the literature and tolerance was generally high.

Certainty of the Evidence

High

Only four randomised controlled trials, two by the same research group, but all were of high quality. Statistical heterogeneity was very low in the analyses, indicating consistency of findings.

Values and preferences

Substantial variability is expected or uncertain

Splints can be uncomfortable to wear and carry a risk of pressure areas and other skin issues. Compliance may vary.

Resources and other considerations

Factor not considered

Rationale

Given the consistent evidence of no effect from a small number of randomised controlled trials involving people within 6 months of stroke, routine use of hand and wrist orthoses is not recommended. While there are a limited number of trials involving small sample sizes, all trials included power calculations and the size of the effect (0.04 to 1 degree of joint range) and the narrow confidence intervals indicate that statistical power was not a concern in these trials. There is little evidence to guide practice of use of orthoses later after stroke. See also the Managing complications chapter.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Orthosis
Comparator: Usual care

Summary

A systematic review by Tyson et al (2011) *[228]* included 4 trials (total N = 126) of upper limb orthotics in stroke survivors. Pooling data from 2 included trials showed non-significant differences in upper limb function, range of movement and pain. Although confidence intervals were wide due to the low sample sizes involved, the plausible range of effects appeared to be clinically insignificant. Based on this review, use of wrist and hand orthoses do not improve either arm function or improve range of motion.

Alexander et al (2021) *[418]* reviewed dynamic hand orthoses (DHO) compared to placebo, no intervention or usual care with four studies and 56 participants. DHO improved upper limb function using ARAT (MD 6.23, 95% CI 0.28 to 12.19, 2 studies, n=29) and dexterity using BBT (MD 2.99, 95% CI 0.39 to 5.60; 4 studies, n= 47). DHO had no effect on activities of daily living measured with grip strength and FMUE (SMD 0.27, 95% CI -0.30 to 0.84; 4 studies, n= 48).

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Orthosis	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Arm function Post intervention 8 Critical	Measured by: Motor Assessment Scale Scale: 0 — 18 High better Based on data from 91 participants in 2 studies. [1] (Randomized controlled) Follow up: 4 weeks of treatment.	Difference:	**MD 0.37 higher** (CI 95% 0.19 lower — 0.93 higher)	**Moderate** Due to serious imprecision [2]	Use of hand and wrist orthosis probably has little or no difference on arm function
Range of motion	Measured by: Joint range	degrees (n/a)	degrees (n/a)	**High**	Use of hand and wrist

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Orthosis	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
of the wrist Post intervention 7 Critical	of motion at the wrist Scale: 0 — 70 High better Based on data from 121 participants in 3 studies. [3] (Randomized controlled) Follow up: 4 to 13 weeks of treatment.	Difference:	**MD 0.04 higher** (CI 95% 5.21 lower — 5.3 higher)	While sample sizes are small results are consistent in finding no effect [4]	orthosis has no effect on range of motion of the wrist

1. Systematic review [228] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
3. Systematic review [228] . **Baseline/comparator:** Control arm of reference used for intervention.
4. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients, but consistent results. **Publication bias: no serious.** Unlikely to see larger studies as evidence of no effect currently.

Attached Images

Weak recommendation against

Brain stimulation (transcranial direct stimulation or repetitive transcranial magnetic stimulation) should not be used in routine practice for improving arm function, and only used as part of a research framework. (Elsner et al. 2020 *[215]*; van Lieshout et al (2019)*[248]*; Hao et al. 2013 *[219]*)

Practical Info

Specialist equipment is required for brain stimulation. Optimal dosages are unknown, as is the optimal timing of conjunctive motor training.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Both repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) are safe interventions (Elsner et al. 2016 *[277]*; Hao et al. 2013 *[219]*). Adverse events are rare and transient. There is little evidence of the beneficial effects of brain stimulation on arm activity.

Certainty of the Evidence

Moderate

The quality of the evidence is moderate.

Values and preferences

No substantial variability expected

People with stroke are unlikely to have strong preferences for brain stimulation.

Resources and other considerations

Important issues, or potential issues not investigated

No cost effectiveness studies were identified. Brain stimulation is not equipment is not readily available in clinical practice.

Rationale

There is currently insufficient evidence to support the use of brain stimulation (transcranial direct current stimulation [tDCS] or repetitive transcranial magnetic stimulation [rTMS]) on improving arm activity. Two Cochrane reviews found no significant benefit of either tDCS (Elsner et al. 2020 *[215]*) or rTMS (Hao et al. 2013 *[219]*) on arm motor function. However, there may be beneficial effects on measures of impairment and ADL but equipment is not readily available in clinical practice and so brain stimulation is most relevant within a research framework.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Transcranial direct current stimulation
Comparator: Placebo or passive control

Summary

A Cochrane review of transcranial direct current stimulation (tDCS) trials included 67 trials with 1729 total participants (Elsner et al 2020 *[215]*). tDCS compared to sham stimulation or passive control reported improvements in activities of daily living (ADL) at the end of the intervention (SMD 0.24, 95% CI 0.03 to 0.44; 19 studies, n=686) along with the end of follow-up (SMD 0.31, 95% CI 0.01 to 0.62; 6 studies, n=269). However, neither of these effects remained significant when analysis was restricted to studies with adequate allocation concealment, suggesting a high risk of bias. There was no significant effects on arm activity at the end of intervention (SMD 0.17, 95% CI -0.05 to 0.38; 24 studies, n=792; moderate-quality evidence) or after follow-up (SMD -0.00, 95% CI -0.39 to 0.39; 5 studies, n=211; moderate-quality evidence). There was no significant difference in adverse events or drop outs (RR 1.25, 95% CI 0.74 to 2.13; 47 studies, n=1330; moderate-quality evidence).

Marquez et al (2015) *[218]* conducted a systematic review of 15 moderate/high quality studies, pooling data according to different stimulation and patient characteristics. There was no benefit of any particular type of tDCS compared to sham (anodal: SMD 0.05, 95%CI -0.25 to 0.31; cathodal: SMD 0.39, 95%CI -0.05 to 0.82; bihemispheric: SMD 0.24, 95%CI -0.3 to 0.77). When data was pooled according to time since stroke, tDCS produced a significant improvement in function for those with chronic stroke (SMD 0.41, 95%CI 0.09 to 0.80) but not those with subacute stroke (SMD 0.01, 95%CI -0.39 to 0.4). Similarly there appears to be a differential finding according to stroke severity whereby when the data for those with mild/moderate impairment was pooled there was significant improvement (SMD 0.37, 95%CI 0.05 to 0.70) but not those with severe impairments (SMD - 0.05, 95%CI -0.38 to 0.28). The size of the treatment effect is variable and at best modest with a maximum effect size of 35% improvement when measured directly following the stimulation.

Tedesco et al (2016) pooled results of 9 studies of tDCS in combination with therapy but revealed no significant benefit of tDCS.

Outcome Timeframe	**Study results and measurements**	**Comparator** Placebo or passive control	**Intervention** tDCS	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Dropouts, adverse events and deaths (risk difference) During intervention period (3 months) 7 Critical	Relative risk 1.25 (CI 95% 0.74 — 2.13) Based on data from 1,330 participants in 47 studies. [1] (Randomized controlled) Follow up: Intervention completion, 3 months.	34 per 1000 Difference:	42 per 1000 **8 more per 1000** (CI 95% 9 fewer — 38 more)	Moderate [2]	tDCS poses low risk to people with stroke

Outcome Timeframe	**Study results and measurements**	**Comparator** Placebo or passive control	**Intervention** tDCS	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Upper extremity function at the end of the intervention period [3] Up to 6 weeks of treatment 7 Critical	Measured by: Various - ARAT, JTT, FM-UE, NHPT High better Based on data from 792 participants in 24 studies. [4] (Randomized controlled) Follow up: Up to 6 weeks of treatment.	Difference:	**SMD 0.17 higher** (CI 95% 0.05 lower — 0.38 higher)	Moderate [5]	tDCS may have little or no difference on upper extremity function at the end of the intervention period
Upper extremity function to the end of follow-up At least 3 months post intervention 7 Critical	Measured by: Various - ARAT, JTT, FM-UE, NHPT High better Based on data from 211 participants in 5 studies. [6] (Randomized controlled) Follow up: atleast 3 months.	Difference:	**SMD 0 higher** (CI 95% 0.39 lower — 0.39 higher)	Moderate [7]	tDCS may have little or no difference on upper extremity function by the end of follow-up

1. Systematic review [215] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Wide confidence intervals. **Publication bias: no serious.**
3. Data for this outcome comes from 12 studies reporting absolute upper extremity scores at the end of intervention. 4 studies reported only change scores are were not pooled with these results.
4. Systematic review [215] with included studies: Viana 2014, Tedesco Triccas 2015b, Rossi 2013, Wu 2013a, Fusco 2013a, Lee 2014, Kim 2010, Bolognini 2011, Di Lazzaro 2014b, Hesse 2011, Di Lazzaro 2014a, Lindenberg 2010. **Baseline/ comparator:** Control arm of reference used for intervention.
5. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Wide confidence intervals. **Publication bias: no serious.**
6. Systematic review [215] . **Baseline/comparator:** Control arm of reference used for intervention.
7. **Inconsistency: serious. Indirectness: no serious. Imprecision: serious.** Wide confidence intervals. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Repetitive transcranial magnetic stimulation
Comparator: Usual care

Summary

A Cochrane review of trials of rTMS included 19 trials with a total of 588 participants (Hao et al 2013 *[219]*). Meta-analysis of 2 trials (N = 183) reporting Barthel Index scores showed a non-significant increase following rTMS treatment (MD 15.92, 95% CI -2.11 to 33.95). Pooled analysis of 4 trials (N = 73) showed a non-significant increase in motor function (SMD 0.51, 95% CI -0.99 to 2.01).

van Lieshout et al (2019)*[248]* included 38 studies (n=1,074). Repetitive transcranial magnetic stimulation (rTMS) improved measures of impairment (SMD 0.43, 95%CI 0.21 to 0.65; moderate heterogeneity (I2=60%). However, there

was no difference in arm activity measures (SMD 0.17, 95%CI -0.009 to 0.44). Early (<1 month) treatment may lead to better outcomes compared to subacute and chronic phases based on the FMugl-Meyer arm scale. Subgroup analysis found effect sizes were largest for studies with >10 number of treatment sessions but there was no difference found for rTMS frequency (high/low) or studies that included additional therapy vs rTMS alone.

Xiang et al (2019)*[249]* included 42 studies (n=1,168) involving the upper and lower limb. ADL was found to improve significantly (SMD 0.82, 95%CI 0.59 to 1.05; 7 studies, n=370). Motor function was also improved (SMD 0.50) but was a mix of impairment and activity scales and it is unclear the effect on activity alone. O'Brien et al (2018)*[250]* included 22 studies (n=351) of non-invasive brain stimulation specifically assessing hand function. Based on 11 comparisons rTMS may improve hand activity (hedges' g 0.46, 95%CI 0.00 to 0.92) but in studies at low risk of bias the result was non-signficant (hedges' g 0.08, 95%CI -0.25 to 0.41; six comparisons). Zhang et al (2017)*[251]* included 22 studies of low-frequency rTMS. Pooling 10 studies (n=299) found a small effect on measures of arm activity directly after treatment (SMD 0.32, 95%CI 0.09 to 0.55) which was no longer significant after 1 month or more follow up (SMD 0.14, 95%CI -0.22 to 0.49).

Overall the evidence demonstrates rTMS may improve measures of impairment but does not appear to improve measures of arm activity.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** rTMS	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Arm activity Post intervention 6 Important	Measured by: Jebsen Taylor Test, Action Research Arm Test, and Wolf Motor Function Test. High better Based on data from 495 participants in 20 studies. [1] (Randomized controlled) Follow up: Post intervention.	Difference:	**SMD 0.17 higher** (CI 95% 0.09 lower — 0.44 higher)	**Moderate** Due to serious inconsistency, Due to serious risk of bias [2]	rTMS may have little or no difference on arm activity

1. Systematic review [248] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:49 %., The direction of the effect is not consistent between the included studies. **Indirectness: no serious. Imprecision: no serious.** Wide confidence intervals. **Publication bias: no serious.**

Attached Images

Participation restrictions

Activities of daily living

Assessment and management of activities of daily living (ADL) fall into two areas:

- Personal ADL, including basic self-maintenance tasks such as showering, toileting, dressing, and eating.
- Extended ADL, including domestic and community tasks such as home maintenance, management of financial affairs and community access, including driving.

Interventions targeting areas such as sensorimotor impairments and physical activities, cognition, communication, leisure and driving, all impact on ADLs. Please refer to other sections of these Clinical Guidelines for interventions targeting these specific impairments. This topic focuses on interventions to improve function and independence in personal and extended ADLs, including occupationally focussed and pharmacological therapies. See also other chapter sections on driving and community ambulation. No recommendation has been made regarding cognitive rehabilitation to improve ADL performance due to inconsistency in the literature, and further trials are recommended (Hoffmann et al. 2010 *[274]*).

Around 87% of stroke survivors in Australia were considered to have difficulties with ADL (Stroke Foundation 2020 *[8]*). The majority of stroke survivors receive some intervention and ADL training in hospitals, including task-specific practice (94%) and training in use of appropriate aids and equipment (66%) (Stroke Foundation 2020 *[8]*).

Strong recommendation

- Community-dwelling stroke survivors who have difficulties performing daily activities should be assessed by a trained clinician. (Legg et al. 2017 *[269]*)
- Community-dwelling stroke survivors with confirmed difficulties in personal or extended activities of daily living should have specific therapy from a trained clinician (e.g. task-specific practice and training in the use of appropriate aids) to address these issues. (Legg et al. 2017 *[269]*)

Practical Info

Tailored ADL training should be provided at home to stroke survivors with ADL difficulties, as part of routine therapy. Intervention and therapy sessions may focus on personal ADL (dressing, bathing) or extended ADL (cooking, laundry tasks). Ensure all sessions engage the stroke survivor in the process and respect their dignity.

Further information can be found in the Driving, Community transport and Return to work guidelines in Chapter 8 of these guidelines.

Evidence To Decision

Benefits and harms — Substantial net benefits of the recommended alternative

Based on a Cochrane review (Legg et al. 2017 *[269]*), ADL performance was improved, and the odds of a poor outcome were reduced (127 fewer death, dependent or deterioration in ADL per 1000 patients treated) when occupational therapy intervention was provided to stroke survivors living in the community.

Certainty of the Evidence — Low

The methodological quality of evidence (9 trials) was low.

Values and preferences — No substantial variability expected

All people affected by stroke and with difficulties with ADL who are living at home, either alone or with family, would want to receive assessments and tailored therapies. There are no reported adverse events.

Resources and other considerations

No important issues with the recommended alternative

Implementation considerations

There are no clinical indicators collected in the National Stroke Audit on occupational therapy interventions for stroke survivors living in the community, but there are clinical indicators collected on whether an assessment by an occupational therapist took place within the inpatient setting and the median time between a patient's admission and this assessment. For patients, in acute care or rehabilitation, who have difficulties with activities of daily living, clinical indicators are collected on the management for these difficulties. These include task-specific practice and trained use of appropriate aids. There is also an organisational indicator collected on whether or not hospitals have locally agreed assessment protocols for ADL.

Rationale

The 2017 Cochrane review included 9 trials of low to moderate quality, which demonstrated improvements in ADL performance when ADL training was provided at home (Legg et al. 2017 *[269]*). Furthermore, there was a reduction in the odds of a poor outcome (death, dependency or deterioration in ADL). Overall the data supports the provision of occupational therapy but the confidence in the data is limited. . Therefore, performance of daily activities should be assessed and managed by a trained clinician, but the optimal approach is yet to be determined.

Surprisingly little research has been conducted with hospital inpatients, therefore no recommendation can be made about the effect of interventions to improve ADL performance for this group. All RCTs in the 2017 Cochrane Review recruited community-dwelling stroke survivors. There was one excluded (feasibility/pilot) RCT which may be of interest to clinicians evaluated dressing retraining with inpatients (Walker et al 2012*[273]*). Further studies are needed before a recommendation can be made.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Occupational therapy
Comparator: Control

Summary

Gibson et al (2022) conducted an updated Cochrane review *[512]* including 24 studies (n - 1,142) assessing the impact of occupational therapy on activities of daily living in patients with cognitive impairment following a stroke. Reporting that the evidence is very uncertain about the effect of occupational therapy on ability to do activities in the home and community, and 'higher level' information-processing skills that co-ordinate and control other cognitive skills. There was insufficient evidence of an effect on ability to do self-care activities three months after receiving the therapy and on getting back into community activities. **[this updated review contains 23 additional studies than the previous Cochrane review]**

~~Han et al (2020) *[297]* [296] conducted a study evaluating the effect of home-based reablement programs which involved activities of daily living (ADL) training (n=26). Compared to conventional rehabilitation in hospital, the home-based rehabilitation group showed significant improvements in ability scale (SRD 0.34, p= 0.0026) and total score (SRD 0.42, p= 0.004) of the Barthel index-based supplementary scales.~~

Qin et al (2022) *[476]* reviewed 21 studies comparing home-based rehabilitation with institution-based rehabilitation. Home-based rehabilitation combined with usual care showed a significant short-term effect on the ability to do basic daily activities, compared with usual care alone (SMD=0.55; 95% CI: 0.22 to 0.87) **{includes Han et al (2020)[297] - remove this study from summary}**

A review completed by Diaz-Arribas et at 2020 *[164]*explored the effectiveness of Bobath with other rehabilitation methods (15 studies, n = 781). From best evidence synthesis, the superiority of the Bobath concept cannot be concluded nor that of any other approach regarding activities of daily living (8 studies, n = 412).

Legg et al (2017) *[269]* assessed the effectiveness of occupational therapy-led interventions in a Cochrane review, specifically focussing on personal activities of daily living. Nine ~~(~~RCTs~~)~~ were included (8 from previous version and one new trial), with most using concealed randomisation and blinding of outcome assessors. Control groups generally received usual care or no intervention. Odds of a poor outcome (death, dependency or deterioration on ADL measures) were reduced in patients receiving occupational therapy interventions (OR 0.67, 95% CI 0.51 to 0.87), and personal activities of daily living were improved (SMD 0.18, 95% CI 0.04 to 0.32). Sensitivity analyses showed that excluding trials with risk of bias reduced these effects somewhat, but treatment effects were generally still significant after these exclusions. However, the best form of occupational therapy could not be determined. The authors also suggested that

the results might only be applicable to people living at home after stroke as the included studies largely involved patients living at home. Another individual data meta-analysis of community occupational therapy pooled data from 8 RCTs (N = 1143) and found significant improvement in personal and extended activities of daily living, which is in line with the findings from the Cochrane review.

~~Since that 2006 systematic review, a few underpowered pilot RCTs and feasibility studies have been published (Tomori et al 2015 *[270]*; Rotenberg-Shpigelman et al 2012 *[201]*; Shinohara et al 2012 *[201]*; Liu et al 2014 *[201]*; Walker et al 2012 *[273]*). Some of these RCTs involved stroke inpatients (Lui et al, 2014 *[201]*; Walker et al 2012 *[273]*). However, none were powered to show a between-group difference (sample sizes range from 23-70) and no intervention has shown superiority over others.~~ A multi-centre RCT of high methodological quality and adequate sample size (N=280) (Giudetti et al 2015 *[271]*) compared a client-centred ADL intervention to usual ADL treatment. The client-centred intervention involved collaboration between the client and the occupational therapist in identifying goals and developing strategies for meeting them. The primary outcomes were changes in the participation domain of the Stroke Impact Scale over 12 months. Odds of positive meaningful change favoured the client-centred intervention group but were non-significant (OR 1.53, 95% CI 0.93 to 2.51), and similarly the odds of negative meaningful change were non-significant (OR 0.67, 95% CI 0.38 to 1.19). The authors published a 5 year follow up to this study in 2022 *[509]* (n = 145); results found that perceived participation significantly improved in both groups, between time periods 3 months - 12 months, and 3 months - 5 years. However, improvements in participation of activities of daily living in the intervention between 12 month (M = 66.5 SD±20.5) and 5 year (M = 68.5 SD±20.8) follow up were not significant. The control group also reported non-significant improvements in participation between 12 month (M = 71.6 SD±20.5) and 5 year (M = 75.5 SD±21.0) follow up.

Overall, the current evidence supports the provision of occupational therapy to improve personal ADL in the community, with less evidence of benefit to inpatients. There is insufficient evidence about which approach or content is most effective, or how much ADL training is needed to improve performance.

Adamit et al (2021) *[504]* studied (n = 66) functional and cognitive occupational therapy (FaCoT) compared to standard care in mild stroke patients. Outcomes measured by Canadian Occupational Performance Measure (COPM); The intervention group reported significant change in performance (M = 153.2%, SD±170.9) and satisfaction (M = 241.0% SD±248.4) compared to the control group (M = 53.0% SD±133.5 and M = 88.4% SD±161.9 respectively). Outcomes measured by Reintegration to Normal Living index (RNL) reported a significant change in the intervention group (M = 13.7% SD±24.1) compared to the control group (M = 6.9% SD±32.9).

Alsubibeen et al (2022) *[506]* studied (n = 30) the effects of 8-week task orientated activities of daily living training compared to standard occupational therapy, on chronic stroke patients with hemiplegia 6 months after onset. Secondary outcome measured activities of daily living using the modified Barthel Index (MBI). Significant improvements were found in activities of daily living MBI scores for both the intervention (M = 78.80 SD±13.15) and control groups (M = 74.13 SD±12.15), for the affected side of body only.

Batool et al (2022) *[507]* studied (n = 64) the effects of visual scanning exercises in addition to task-specific approach on balance and activities of daily living on stroke patients with eye movement disorders. Measured on the Barthel Index (BI), significant improvements in activities of daily living were found for both the intervention (MD = 14.38 SD±5.22) and control (MD = 5.94 SD±2.98).

Yu and Park (2022) *[528]* studied (n = 20) the effects of First-person Perspective Action Based Observation training compared to Third-person Perspective Action Based Observation training in upper limb motor function. Measured by modified Barthel Index total scores, First-person training was more effective in improving activities of daily living (M = 60.60 SD± 12.16) than third-person training (M = 65.10 SD± 11.68).

Azevedo et al (2022) *[529]* reviewed 15 studies (n = 546) comparing constraint-induced movement therapy to standard therapy in motor function. Subgroup analysis measured by modified Barthel index indicated than the intervention significantly improved activities of daily living (M = 10.66; 95% CI: 7.75 to 13.56, 3 studies, n = 62) compared to the control.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Occupational therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Death or poor	Odds ratio 0.71 (CI 95% 0.52 — 0.96)	440	313	**Low** Due to serious	Occupational therapy may decrease death or

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Occupational therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
outcome [1] End of follow-up 9 Critical	Based on data from 771 participants in 5 studies. [2] (Randomized controlled) Follow up: 3-12 months.	per 1000 Difference:	per 1000 **127 fewer per 1000** (CI 95% 211 fewer — 17 fewer)	risk of bias, Due to serious imprecision [3]	poor outcome
Activities of daily living End of follow-up 8 Critical	Measured by: Various e.g. Barthel Index, Rivermead ADL scale High better Based on data from 749 participants in 7 studies. [4] (Randomized controlled) Follow up: 3-12 months.	Difference:	**SMD 0.17 higher** (CI 95% 0.03 higher — 0.31 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [5]	Occupational therapy may improve activities of daily living slightly.
Extended activities of daily living End of follow-up 8 Critical	Measured by: Various e.g. Nottingham Extended Activities of Daily Living High better Based on data from 665 participants in 5 studies. [6] (Randomized controlled) Follow up: 3-12 months.	Difference:	**SMD 0.22 higher** (CI 95% 0.07 higher — 0.37 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [7]	Occupational therapy may increase extended activities of daily living

1. death, dependence (mRS >2), deterioration (lower ADL scores)
2. Systematic review [269] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious.** Due to serious risk of bias, Due to serious imprecision. **Inconsistency: no serious. Indirectness: no serious.** Differences between the population of interest and those studied: studies all focussed on patients living at home after stroke. **Imprecision: serious.** Wide confidence intervals, Low number of patients. **Publication bias: no serious.**
4. Systematic review [269] . **Baseline/comparator:** Control arm of reference used for intervention.
5. **Risk of Bias: serious.** Risk of selection, performance bias. **Inconsistency: no serious. Indirectness: no serious.** Differences between the population of interest and those studied: studies all focussed on patients living at home after stroke. **Imprecision: serious.** Wide confidence intervals, Low number of patients. **Publication bias: no serious.**
6. Systematic review [269] . **Baseline/comparator:** Control arm of reference used for intervention.
7. **Risk of Bias: serious.** Risk of selection, performance bias. **Inconsistency: no serious. Indirectness: no serious.** Differences between the population of interest and those studied: studies all focussed on patients living at home after stroke. **Imprecision: serious.** Wide confidence intervals, Low number of patients. **Publication bias: no serious.**

Attached Images

Weak recommendation

For stroke survivors, virtual reality technology may be used to improve activities of daily living in addition to usual therapy. (Laver et al. 2017 *[283]*)

Practical Info

Clinicians may consider purchasing, learning to use, and embedding some virtual reality (VR) technologies into their practice. It

may be more appropriate to offer this therapy to selected stroke survivors (i.e. younger people, aged up to 75 years, and people living in the community) in addition to usual therapy. As some people with stroke can find VR overwhelming it is important to firstly trial it face to face and ensure there are no hypersensitive reactions or problems with balance.

Clinicians will need to learn how to use and administer VR technologies, maintain and repair equipment. Some clinicians may find this process time consuming and prefer to deliver standard practice.

Evidence To Decision

Benefits and harms — Small net benefit, or little difference between alternatives

A Cochrane review showed that the use of virtual reality in conjunction with usual care improved activities of daily living (Laver et al. 2017). There were no reported harms or adverse events such as increased incidence of falls.

Certainty of the Evidence — Moderate

The quality of evidence was moderate.

Values and preferences — Substantial variability is expected or uncertain

Some stroke survivors will want to use, and agree to use virtual reality technology, while others will prefer traditional or standard therapies. Younger stroke survivors and those living in the community are more likely to accept and participate in therapies involving virtual reality technology. Some older people may be hesitant to try this technology due to an unfamiliarity with technology in general.

Resources and other considerations — Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

The 2017 Cochrane review included 10 trials that investigated the effect of virtual reality technology on ADL (Laver et al. 2017 *[283]*). Virtual reality was found to have a small benefit when compared to the same dose of conventional therapy, however, when used in addition to standard care virtual reality therapy improved ADL outcomes (moderate effect size). Virtual reality is becoming more common and can aide patient motivation and impact on ADL outcomes.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Virtual reality
Comparator: Conventional therapy

Summary

A Cochrane Review by Laver et al (2017) *[283]* found 10 studies (n=466) that measured ADL abilities within the 72 studies included in their review comparing virtual reality (VR) to conventional therapy. A small difference in ADL ability was found, favouring the intervention compared to same dose of conventional therapy (SMD 0.25) but in sensitivity analysis removing four studies at unclear or high risk of bias the results were smaller and non-significant (SMD 0.20, 95% CI -0.01 to 0.40).

However, when comparing the addition of VR plus routine therapy there was a moderate effect size (SMD 0.44, 95% CI 0.11 to 0.76; low certainty evidence) for improving ADL ability based on eight studies (n=153). Sensitivity analysis of two trials deemed at low risk of bias found stronger effects but wider confidence intervals (SMD 0.92, 95% CI 0.04 to 1.81). . However, there was no evidence that effects were sustained long-term. This intervention is relatively safe.

Chen et al (2022) *[508]* reviewed 21 studies (n = 1,149) comparing the effects of virtual reality (VR) rehabilitation training to conventional treatment, in patients with poststroke cognitive impairment. VR rehabilitation significantly improved activities of daily living measured on Barthel Index (MD = 6.14, 95% CI: 4.56 to 7.72, 4 studies, n = 212) compared to control. VR rehabilitation also significantly improved activities of daily living measured by the modified Barthel Index (MD = 3.80, 95% CI: 1.55 to 6.06, 4 studies, n = 219) compared to the control. VR rehabilitation training may be a good addition to conventional cognitive interventions.

Leong et al (2022) *[513]* reviewed 50 studies (n = 2,271) exploring the use of virtual reality (VR), augmented reality (AR) and mixed reality (MR) technologies in upper limb rehabilitation and activities of daily living. Outcomes of activities of daily living were measured using the Functional Independence Measure (FIM). Subgroup analysis reported a significant improvement in activities of daily living (MD = 4.25, 95% CI: 1.47 to 7.03) compared to control group. High heterogeneity of included studies.

Zhang et al (2023) *[521]* reviewed 52 studies (n = 1,559) evaluating the effect of robot-assisted and virtual reality interventions on balance, gait and daily function. Subgroup analysis reported that the virtual reality intervention was most likely to be ranked as superior according to SUCRA (92%, MD= -7.85, 95% CI: -15.18 to -1.07). Virtual reality had a more significant improvement of modified Barthel Index compared to robot-assisted interventions (MD = 7.48, 95%CI: 0.26 to 16.42) and conventional therapy (MD = -7.85, 95% CI: -15.18 to -1.07).

Park et al (2021) *[525]* studied (n = 44) the effects of a glove-type wearable virtual reality device on upper limb function compared to conventional physical therapy. The intervention had a significant improvement in activities of daily living measured on modified Barthel index (change, M = 31.68 SD± 19.79) compared to the control group (change, M = 21.63 SD± 17.94).

Mugisha et al (2022) *[526]* reviewed 22 studies (n = 1,253) on the effects of either immersive or non-immersive virtual reality interventions, compared to conventional therapy. Subgroup analysis of immersive virtual reality interventions on upper limb function indicated a greater improvement in activities of daily living in the intervention group, with a moderate effect size (SMD = 0.54, 95% CI: 0.15 to 0.93,3 studies, n = 109) compared to the control.

Outcome Timeframe	**Study results and measurements**	**Comparator** Conventional therapy	**Intervention** Virtual reality	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
ADL [1] Post intervention 8 Critical	Measured by: Various e.g. Functional Independence Measure, Barthel Index High better Based on data from 466 participants in 10 studies. [2] (Randomized controlled)	Difference:	**SMD 0.25 higher** (CI 95% 0.06 higher — 0.43 higher)	**Moderate** Due to serious risk of bias in some studies [3]	Virtual reality probably improves ADL slightly

1. Measures of ADL, such as Barthel Index, Functional Independence Measure, and modified Rankin Scale
2. Systematic review [283] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious.** Risk of bias was unclear in a number of studies.. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** small total population size. **Publication bias: no serious.**

Attached Images

Weak recommendation against

For older stroke survivors living in a nursing home, routine occupational therapy is not recommended to improve activities of daily living function. (Sackley et al. 2015 *[268]*)

Practical Info

Although some stroke survivors in a nursing home may receive tailored occupational therapy for specific reasons, routine occupational therapy directed at ADL training is not recommended. Some, but not all stroke survivors may have received active rehabilitation prior to being discharged to a nursing home.

Evidence To Decision

Benefits and harms — Small net benefit, or little difference between alternatives

There was little benefit in ADL function but also no harms (Sackley et al. 2015 *[268]*). The fall rate over 3 months was within the normal range based on recently published data (1.49 to 2.5 falls per year) (Sackley et al. 2015 *[268]*).

Certainty of the Evidence — Low

Although the Sackley study *[268]* was well-designed, this is the only trial on this topic and the participants had a high level of disability.

Values and preferences — Substantial variability is expected or uncertain

Although no study to date has reported on the preferences and values of stroke survivors in nursing homes, stroke survivors and their carers are likely to want therapy to maintain or improve function. Therefore it is important to highlight what this study intervention involved, the dose of intervention and the sub-group of stroke participants. See Rationale.

Resources and other considerations — Important issues, or potential issues not investigated

The intervention involved a mean of 5 visits x 30 minutes of occupational therapy time which is an additional cost. Given the lack of effect on ADL, this intervention is not considered cost effective.

Rationale

To date, only one large trial by Sackley et al (2015) *[268]* has evaluated the outcomes of occupational therapy in nursing homes. No benefit was found on ADL performance at any time (3, 6 or 12 months) despite providing a relatively expensive intervention vs usual care (mean of 5 visits x 30 minutes vs no occupational therapy).

Clinical Question/ PICO

Population: Older adults with stroke in nursing homes
Intervention: Occupational therapy
Comparator: Control

Summary

A high-quality cluster randomised controlled trial (RCT) by Sackley et al (2015) *[268]* showed no effect or benefit on ADL (Barthel Index) outcome at any time (3, 6 or 12 months) from a somewhat expensive occupational therapy (OT) intervention (mean 5 visits x 30 mins) compared to no intervention/usual care (no OT). No other comparable RCTs were found involving stroke participants for comparison. However, the authors point to 2 other RCTs in nursing homes involving older residents (non-stroke) which produced negative results, i.e. evidence of no effect or difference from the active intervention – (a) exercise for depression in older residents, and (b) a functional activity program to improve function in nursing home residents. Overall, the research suggests that an occupational therapy-led program provided to older stroke participants in a nursing home is unlikely to improve function, compared to no therapy or usual care.

Braun et al (2012) *[180]* conducted a multicenter randomised trial assessing the impact of mental practice instruction in addition to usual care in Dutch nursing homes. The study was of good methodological quality. It showed no effect or benefit on any outcome from embedding mental practice into usual therapy for stroke patients during rehabilitation.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Occupational therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
ADL (3 months) [1] 3 months 8 Critical	Measured by: Barthel Index (reported difference is covariate-adjusted) Scale: 0 — 20 High better Based on data from 976 participants in 1 studies. [2] (Randomized controlled) Follow up: 3 months.	5.29 points (Mean) Difference:	5.47 points (Mean) **MD 0.19 higher** (CI 95% 0.33 lower — 0.7 higher)	**Low** Due to serious indirectness, Due to serious imprecision [3]	occupational therapy may have little or no difference on adl (3 months)
ADL (6 months) [4] 6 months 8 Critical	Measured by: Barthel Index (reported difference is covariate-adjusted) Scale: 0 — 20 High better Based on data from 973 participants in 1 studies. [5] (Randomized controlled) Follow up: 3 months.	4.78 (Mean) Difference:	4.78 (Mean) **MD 0 higher** (CI 95% 0.52 lower — 0.53 higher)	**Low** Due to serious indirectness, Due to serious imprecision [6]	occupational therapy may have little or no difference on adl (6 months)
ADL (12 months) [7] 12 months 8 Critical	Measured by: Barthel Index (reported difference is covariate adjusted) Scale: 0 — 10 High better Based on data from 942 participants in 1 studies. [8] (Randomized controlled) Follow up: 3 months.	3.77 (Mean) Difference:	3.93 (Mean) **MD 0.16 higher** (CI 95% 0.4 lower — 0.72 higher)	**Low** Due to serious indirectness, Due to serious imprecision [9]	occupational therapy may have little or no difference on adl (12 months)

1. ADL measured by Barthel index. Participants who died were given a BI score of 0.
2. Primary study[268]. **Baseline/comparator:** Control arm of reference used for intervention.
3. **Inconsistency: no serious. Indirectness: serious.** Differences between the population of interest and those studied: nearly half of the residents with stroke (47%) had a BI in the 'very severe range' (ie BI score 0 to 4).The mean BI was 6.5 and 6.3, compared to their pilot study where the mean BI score was in the moderate range (score 10-14). The level of baseline disability may partly account for the lack of effect (compared to pilot study).. **Imprecision: serious.** Only data from one study. **Publication bias: no serious.**
4. ADL measured by Barthel index. Participants who died were given a BI score of 0.
5. Primary study[268]. **Baseline/comparator:** Control arm of reference used for intervention.
6. **Inconsistency: no serious. Indirectness: serious.** Differences between the population of interest and those studied: nearly half of the residents with stroke (47%) had a BI in the 'very severe range' (ie BI score 0 to 4).The mean BI was 6.5 and 6.3, compared to their pilot study where the mean BI score was in the moderate range (score 10-14). The level of baseline disability may partly account for the lack of effect (compared to pilot study).. **Imprecision: serious.** Only data from one study. **Publication bias: no serious.**
7. ADL measured by Barthel index. Participants who died were given a BI score of 0.
8. Primary study[268]. **Baseline/comparator:** Control arm of reference used for intervention.
9. **Inconsistency: no serious. Indirectness: serious.** Differences between the population of interest and those studied: nearly half of the residents with stroke (47%) had a BI in the 'very severe range' (ie BI score 0 to 4).The mean BI was 6.5 and 6.3, compared to their pilot study where the mean BI score was in the moderate range (score 10-14). The level of baseline disability may partly account for the lack of effect (compared to pilot study).. **Imprecision: serious.** Only data from one study. **Publication bias: no serious.**

Attached Images

Weak recommendation against

Acupuncture is not routinely recommended to improve activities of daily living. (Yang et al. 2016 *[294]*)

Practical Info

While some stroke survivors may want to purchase acupuncture, the evidence suggests there is unlikely to be consistent benefits. However, there do not appear to be any harms, risks or safety concerns if stroke survivors choose to pursue this treatment independently. Measures of ADL outcomes should be obtained before and after treatment by treating therapists to determine if acupuncture is improving (or reducing) ADL performance. Most Australian hospitals do not permit acupuncture therapists to deliver treatment to stroke inpatients in their facilities.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Acupuncture is an intervention that appears to lead to little or no harm, but results in no worthwhile benefits compared to other treatments. Therefore, acupuncture cannot be recommended routinely to improve ADL. The evidence on which this recommendation is based is very low quality (Yang et al 2016).

Certainty of the Evidence

Very low

The quality of evidence is very low, with most published RCTs included in the 2016 Cochrane review reporting very brief methods and results (2 pages or less) (Yang et al 2016).

Values and preferences

Substantial variability is expected or uncertain

Some patients may prefer or value acupuncture and other traditional Chinese treatments due to perceived benefits beyond ADL. This type of treatment is rarely available in Australian hospital settings, and is not recommended to improve ADL at this time. Acupuncture to improve ADL has not yet been shown to result in benefits.

Resources and other considerations

Important issues, or potential issues not investigated

No cost-effective studies were identified. Acupuncture requires skills and experience to perform and access to those with this experience is likely to be limited outside of major urban areas.

Rationale

There is very low quality evidence showing that acupuncture may improve ADL measures, but uncertainty and poor study reporting has led to this recommendation being a weak recommendation against acupuncture (Yang et al 2016 *[294]*). Previous data with sham control showed little or no difference to ADL performance, irrespective of time post-stroke (Kong et al. 2010 *[278]*). Until more quality evidence is available, acupuncture is not recommended as part of routine care in Australia or New Zealand.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Acupuncture

Comparator: Control

Summary

A Cochrane review included 11 studies that reported changes in ADL ability (Yang et al 2016 *[294]*). Nine of the studies were pooled (n=616) with an increase in ADL reported~~ability found~~, however, this finding was based on very low quality evidence. The methods and results in many RCTs were very brief (often two pages in length) limiting interpretation and critical appraisal.

An earlier (non-Cochrane)~~other older~~ systematic review of 10 studies (Kong et al 2010 *[278]*) has investigated the efficacy of acupuncture in patients with stroke, irrespective of time post-event. Of the five studies that investigated the impact of acupuncture on activities of daily living (ADL) outcomes in the acute and sub-acute phase, ~~only~~ three ~~used quality methods that have~~ had low levels of bias. The combined findings of these three studies indicate that acupuncture does not influence ADL outcomes after stroke in the first few days and weeks post event. Three studies also investigated outcomes in patients with chronic stroke and the combined findings indicated that, as with the acute and sub-acute phase, acupuncture does not influence ADL outcomes after stroke.

Wang et al (2020)*[298]* conducted a study evaluating the efficacy of scalp-acupuncture on participants with hemiplegic paralysis one to seven days post stroke (n= 120). Compared to standard care, the acupuncture group had a greater increase in activities of daily living (p = 0.028) from pre- to post- intervention. No serious adverse events were observed in the control group, but the acupuncture group had mild fainting (5%, n=3) and scalp haematoma (25%, n=15).

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Acupuncture	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
ADL [1] 3 months 8 Critical	Measured by: Barthel Index High better Based on data from 616 participants in 9 studies. [2] (Randomized controlled) Follow up: 3 months.	Difference:	**MD 9.19 higher** (CI 95% 4.34 higher — 14.05 higher)	**Very low** Due to serious risk of bias, Due to serious inconsistency [3]	We are uncertain whether acupuncture increases or decreases ADL.

1. Dependency on Barthel Index (<60)
2. Systematic review [294] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious. Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2:57%..

Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.

Attached Images

Strong recommendation against

Administration of amphetamines to improve activities of daily living is not recommended. (Martinsson et al. 2007 *[281]*)

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

The Cochrane review by Martinsson et al. (2007) *[281]* which included four small RCTs, suggested potential harms from amphetamines – a non-significant trend towards increased mortality. This Cochrane review found no benefit in activities of daily living and a non-significant effect in favour of placebo. The more recent RCT by Lokk et al. (2011) *[282]* suggested modest benefits in ADL following amphetamine intervention combined with usual physiotherapy, but has a high risk of bias.

Certainty of the Evidence

Low

The Cochrane review provided low quality of evidence due to small sample size and imbalances in baseline prognostic factors *[281]*. A more recent RCT by Lokk et al. (2011) had high risk of bias, partly due to lack of assessor blinding *[282]*.

Values and preferences

No substantial variability expected

Given the lack of benefits and potential harms, stroke survivors are unlikely to want to receive amphetamines for the purpose of improving ADL.

Resources and other considerations

Factor not considered

No cost-effective studies were identified.

Rationale

Given the potential risk of death and lack of clear benefits, a strong recommendation has been made against administration of amphetamines.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Amphetamine
Comparator: Placebo

Summary

Martinsson et al (2007) *[281]* -conducted a Cochrane review of amphetamine treatments for patients with stroke, restricting inclusion to randomised trials comparing amphetamine to placebo. 10 RCTs with 287 patients were included, 8 using dexamphetamine and the remaining 2 using methamphetamine or d,l-amphetamine. There were non-significant increases in death or dependency (OR 1.5, 95% CI 0.6 to 3.3) and all-cause mortality (OR 2.8, 95% CI 0.9 to 8.6) in patients treated with amphetamine. The review authors suggested that these apparent differences may have been from imbalances in baseline prognostic factors that were seen in some included studies, e.g. higher age and lower levels of consciousness in the amphetamine groups. There was no indication of an improvement in ADL following amphetamine administration, with meta-analysis of 4 studies finding a non-significant effect in favour of placebo. However, the included trials were small and had baseline equivalence, meaning further research may change these conclusions.

In a more recent trial of an amphetamine-like drug, Lokk et al (2011) *[282]* conducted a double-blind RCT (N = 100) comparing levodopa (LD), methylphenidate (MPH) or their combination to placebo. Outcomes were assessed at 3 and 6 months and included the Barthel Index, Fugl-Meyer assessment and National Institute of Health Stroke Scale (NIHSS). Mean changes from baseline to 6 months showed significant between-group differences for the Barthel Index (total as well as self-care and mobility scales) and NIHSS, with no significant differences on the Fugl-Meyer assessment. Specific comparisons were not reported in the trial but the combined methylphenidate and levodopa group appeared to show the greatest benefit. Outcome assessors were not blinded in this trial, creating a risk of bias, however the patients and the treating doctors were blinded. The results of this trial suggest modest benefits in ADL following amphetamine treatment. This apparent conflict with the results of the Cochrane review may reflect differences in methodology (e.g. the timing of exercise therapy following drug administration) or the baseline differences that were present in the Cochrane review studies.

Outcome Timeframe	**Study results and measurements**	**Comparator** Placebo	**Intervention** Amphetamine	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Death or dependency [1]	Odds ratio 1.45 (CI 95% 0.64 — 3.27)	311 per 1000	396 per 1000	**Low** Due to serious	Amphetamine may increase death or

Outcome Timeframe	**Study results and measurements**	**Comparator** Placebo	**Intervention** Amphetamine	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
End of follow-up 9 Critical	Based on data from 106 participants in 3 studies. [2] (Randomized controlled) Follow up: 3-12 months post stroke.	Difference:	**85 more per 1000** (CI 95% 87 fewer — 285 more)	imprecision, Due to serious indirectness (baseline differences in included studies) [3]	dependency
Death (all causes) End of follow-up 9 Critical	Odds ratio 2.82 (CI 95% 0.92 — 8.6) Based on data from 287 participants in 10 studies. [4] (Randomized controlled) Follow up: 1 day to 12 months.	**22** per 1000 Difference:	**60** per 1000 **38 more per 1000** (CI 95% 2 fewer — 140 more)	**Low** Due to serious indirectness (baseline differences in included studies), Due to serious imprecision [5]	Amphetamines may increase death from all causes
Activities of daily living End of follow-up 8 Critical	Measured by: Barthel Index High better Based on data from 113 participants in 4 studies. [6] (Randomized controlled) Follow up: 10 days to 12 months.	Difference:	**MD 3.87 lower** (CI 95% 13.49 lower — 5.75 higher)	**Low** Due to serious risk of bias (intention to treat analysis showed almost significant effect in favour of placebo), Due to serious imprecision [7]	Amphetamines may have little or no difference on activities of daily living

1. Dependency classified as scores < 60 on the Barthel Index or score of 3-6 on the Oxford Handicap scale.
2. Systematic review [281] . **Baseline/comparator:** Control arm of reference used for intervention.
3. **Inconsistency: no serious. Indirectness: serious.** Differences between the intervention/comparator of interest and those studied: multiple statistically significant baseline differences in included studies. **Imprecision: serious.** Low number of patients, Wide confidence intervals. **Publication bias: no serious.**
4. Systematic review [281] . **Baseline/comparator:** Control arm of reference used for intervention.
5. **Inconsistency: no serious. Indirectness: serious.** Differences between the intervention/comparator of interest and those studied: multiple significant baseline differences in included studies. **Imprecision: serious.** Wide confidence intervals, few events. **Publication bias: no serious.**
6. Systematic review [281] . **Baseline/comparator:** Control arm of reference used for intervention.
7. **Risk of Bias: serious.** In the Cochrane review, an intention to treat analysis showed an almost significant benefit of placebo compared to amphetamine treatment. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Weak recommendation against

Updated evidence, no change in recommendation

Selective serotonin reuptake inhibitors should not be used to reduce disability. (Legg et al. 2021 *[453]*).

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Selective serotonin reuptake inhibitors have no beneficial effects on independence or disability (although may prevent or reduce depression) and can lead to increased falls and bone fractures.

Certainty of the Evidence

High

Quality of evidence from six higher quality RCTs is high.

Values and preferences

We expect few to want the intervention

Given the potential harms and lack of benefits regarding reduced disability there are no expected differences in preferences and values of SSRIs.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

Selective serotonin reuptake inhibitors (SSRIs) have been mainly used for the prevention and treatment of mood disorders such as depression (covered in Chapter Six), not specifically with the aim of reducing disability. SSRIs do not reduce measures of disability based on high certainty evidence. Side effects such as falls, bone fractures, seizures or gastrointestinal harms may occur and as such SSRIs are not routinely recommended.

The primary outcome of the main trials was reduction in disability, rather than activities of daily living. However, the working group have maintained this recommendation within this section because global measures of disability are closely related to measures of activities of daily living.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Selective serotonin reuptake inhibitor
Comparator: Control

Summary

Legg et al (2021) *[453]* updated a Cochrane review on the effects of selective serotonin reuptake inhibitors (SSRIs) in stroke patients. 76 studies were identified (n=13,029), half of which required participants to have depression to enter the trial. Of the 76 included studies, 38 used fluoxetine, eight studies used sertraline, 13 used paroxetine, nine used citalopram, five used escitalopram, one used either sertraline or fluoxetine, and two used citalopram or fluoxetine. Only six of the 76 included studies were rated as low risk of bias across the key domains and were included in the meta-analysis. All six studies compared fluoxetine to placebo and they did not require participants to have depression on enrolment. The duration, drug, and dose varied between studies. The pooled data of five studies (n=5926) found no difference in odds of being independent (modified Rankin Score 0–2) (RR 0.98 95% CI 0.93 to 1.03). There was also no change to disability measured by the Stroke Impact Scale or Barthel Index (SMD 0.00 95% CI -0.05 to 0.05). SSRIs increased the risk of seizure (RR 1.40, 95% CI 1.00 to 1.98; 6 studies, 6080 participants, moderate-quality evidence) and a bone fracture (RR 2.35, 95% CI 1.62 to 3.41; 6 studies, 6080 participants, high-quality evidence).

Sensitivity analysis including all studies reporting disability found SSRI intervention had significantly lower end-of-treatment scores than those participants receiving placebo or standard care/practice (SMD -0.18, 95% CI -0.23 to -0.14; 32 studies, 7667 participants; very high heterogeneity I^2=94%). Possible publication bias was found.

Overall there is no effect of SSRIs on global measures of disability based on good quality studies.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Selective serotonin reuptake inhibitor	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
mRS 0-2 [1] 8 Critical	Relative risk 0.98 (CI 95% 0.93 — 1.03) Based on data from 5,926 participants in 5 studies. (Randomized controlled) Follow up: 90 days.	519 per 1000 Difference:	509 per 1000 **10 fewer per 1000** (CI 95% 36 fewer — 16 more)	**High**	Selective serotonin reuptake inhibitor probably has little or no difference on level of disability
Activities of daily living [2] 8 Critical	Measured by: Disability (SIS or BI) High better Based on data from 5,436 participants in 5 studies. (Randomized controlled)	Difference:	**SMD 0 higher** (CI 95% 0.05 lower — 0.05 higher)	**High**	Selective serotonin reuptake inhibitor probably has little or no difference on disability

1. modified Rankin Scale 3-5
2. Measured by a range of tools including Barthel Index, Functional Independence Measure, and

Attached Images

Weak recommendation against

Brain stimulation (transcranial direct stimulation or repetitive transcranial magnetic stimulation) should not be used in routine practice to improve activities of daily living and only used as part of a research framework. (Elsner et al. 2020 *[215]*; Hao et al. 2013 *[219]*)

Practical Info

Most health services will not have this type of equipment or be able to offer this treatment, except in a research framework. When tDCS or TMS areoffered as part of a research project, measures of ADL performance should be taken before and after treatment.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

In the 2020 Cochrane review of tDCS, ADL outcomes improved immediately following intervention, and at follow-up 3 months later. However, these outcomes following tDCS did not persist when trials with low methodological quality were excluded from analysis (Elsner et al. 2020 *[215]*).

In the 2013 Cochrane review of rTMS, no significant benefits in ADL performance were observed, using the Barthel Index as

a measure of change. There was no difference in outcomes when different stimulation frequencies were compared (Hao et al. 2013 *[219]*). One additional RCT by Liu et al 2020 *[332]*, did report significant improvements in ADL (FIM score) following four weeks of TMS alongside cognitive training on a computer, compared to a group receiving sham TMS and cognitive training. No harms were reported.

Certainty of the Evidence

Low

The quality of evidence overall is moderate for tDCS but low for rTMS.

Values and preferences

Substantial variability is expected or uncertain

Patients' preferences are likely to vary due to the uncertainty in long-term benefits. Some stroke survivors will be enthusiastic to trial novel treatments like TMS if offered by health services, including as part of a research project.

Resources and other considerations

Important issues, or potential issues not investigated

No cost effectiveness studies were identified. Brain stimulation equipment is not readily available in clinical practice.

Rationale

In the updated Cochrane review of tDCS, there was a small improvement in ADL immediately following the intervention and at follow-up 3 months later. However, these outcomes following tDCS did not persist when trials with low methodological quality were excluded from analysis (Elsner et al. 2020 *[215]*). Evidence is evolving and may be more effective with cathodal tDCS (Elsner et al. 2017 *[293]*).

In the 2013 Cochrane review of rTMS, no significant benefits in ADL performance were observed based on two studies, using the Barthel Index as a measure of change. There was no difference in outcomes when different stimulation frequencies were compared (Hao et al. 2013 *[219]*). However, when combined with a subsequent study (Liu et al. 2020 *[332]*) there was a large and significant effect found but serious imprecision and inconsistency. Hence, rTMS shows promise as an intervention but further trials are required.

Given the evolving evidence base and uncertainty we suggest it is not appropriate to recommend brain stimulation as routine pratice but encourage ongoing research into these interventions.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Transcranial direct-current stimulation (tDCS)
Comparator: Placebo or passive control

Summary

A Cochrane review of transcranial direct current stimulation (tDCS) trials included 32~~67~~ trials with 748~~1729~~ total participants (Elsner et al 2020 *[215]* ~~[168]~~). Nine~~teen~~ studies compared tDCS to sham stimulation or passive control reported improvements in activities of daily living (ADL) at the end of the intervention outcomes found a small significant improvement (SMD 0.24, 95% CI 0.0~~1~~3 to 0.44; ~~1~~9 studies, n= ~~68~~396; moderate quality evidence) along with the end of follow-up (SMD 0.31, 95% CI 0.01 to 0.62; 6 studies, n=269; moderate quality evidence). However, neither of these effects remained significant when analysis was restricted to studies with adequate allocation concealment, suggesting a high risk of bias.

Another meta-analysis by the same group (Elsner et al 2017 *[293]*) included 26 studies (n=754) and conducted a network meta-analysis (12 RCTs, n=284) that demonstrated tDCS improved ADL ability (SMD 0.42, 95% CI 0.14 to 0.70). No differences in adverse events or drop outs were noted. Authors reported cathodal tDCS appears to improve

ADL ability more than dual or anodal application.

Pinto et al (2021) *[515]* studied (n = 60) transcranial direct current stimulation (tDCS) effects on inpatients with motor deficits compared to sham tDCS. Activities of daily living was assessed as a co-primary outcome measured by the Barthel Index. Although all patients showed motor improvements, after adjusting for covariates, tDCS was not superior to sham treatment on any motor, mood, or cognitive outcome.

Outcome Timeframe	**Study results and measurements**	**Comparator** Placebo or passive control	**Intervention** Transcranial direct-current stimulation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
ADL [1] Until end of follow-up: mean 3 months 8 Critical	Measured by: Various: e.g. Barthel Index, modified Rankin Score, Functional Independence Measure High better Based on data from 396 participants in 9 studies. [2] (Randomized controlled) Follow up: mean 3 months.	Difference:	**SMD 0.24 higher** (CI 95% 0.03 higher — 0.44 higher)	Moderate Due to serious risk of bias [3]	Transcranial direct-current stimulation may improve ADL until the end of follow-up
ADL [4] End of intervention 8 Critical	Measured by: Various: e.g. Barthel Index, modified Rankin Score, Functional Independence Measure High better Based on data from 269 participants in 6 studies. [5] (Randomized controlled)	Difference:	**SMD 0.31 higher** (CI 95% 0.01 higher — 0.62 higher)	Moderate Due to serious risk of bias [6]	Transcranial direct-current stimulation may improve ADL at the end of intervention

1. A range of ADL measures were included, e.g. Barthel Index, modified Rankin Score, Functional Independence Measure
2. Systematic review [215] . **Baseline/comparator:** Systematic review.
3. **Risk of Bias: serious.** The benefit of tDCS did not persist when only studies of high methodological quality were included. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
4. A range of ADL measures were included, e.g. Barthel Index, modified Rankin Score, Functional Independence Measure
5. Systematic review [215] . **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: serious.** some studies has unclear risk for selective outcome reporting. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Repetitive transcranial magnetic stimulation (rTMS)
Comparator: Control

Summary

A Cochrane review showed a non-significant increase in the Barthel Index score from two heterogeneous trials with a total of 183 participants comparing repetitive transcranial magnetic stimulation (rTMS) treatment with~~and~~ control interventions (Hao et al. 2013 *[219]*). The certainty of evidence was very-low. Subgroup analyses of different stimulation frequencies or duration of illness also did not show a significant difference, and a few mild adverse events were observed in the rTMS groups. Three other studies ~~included~~ in the review were not included in the data analysis due to very short treatment duration.

Xiang et al (2019)*[249]* included 42 studies (n=1,168) involving the upper and lower limb studies. ADL was found to improve significantly (SMD 0.82, 95%CI 0.59 to 1.05; 7 studies, n=370). Motor function was also improved (SMD 0.50) but was a mix of impairment and activity scales and it is unclear the effect on activity alone.

Liu et al. (2020) undertook a RCT in an inpatient rehabilitation setting (n=62). Patients were on average 9 months post-stroke had attention dysfunction and were randomised to 4 weeks of TMS or sham TMS in addition to comprehensive cognitive training which included attention training, orientation training, visual spatial training and logical reasoning training via touch screen computer. The intervention group had significantly improved total FIM scores at the end of the treatment compared to controls (83.9 vs 69.~~5~~5). The~~is~~ study methods were rated as high quality (PEDro 8/10). Combining three studies in an updated meta-analysis resulted in a sig~~n~~ificant improvement ~~o~~in ADL function (SMD 1.16, 95%CI 0.17 to 2.15). However, there was high heterogeneity (I2=91%) serious imprecision and overall there was a low certainty of evidence. All three trials were conducted in China. ~~and f~~

Ahmed et al (2022) *[505]* reviewed 25 studies (n = 1,102) comparing noninvasive brain stimulation (NBIS) to sham control. A secondary outcome measure was participation in activities of daily living measured by Barthel Index (BI). Subgroup analysis revealed that repetitive transcranial magnetic stimulation (rTMS) improved BI scores compared to sham rTMS (MD = 5.13; 95% CI: 2.60 to 7.67, n = 128).

Chen et al (2023) *[518]* reviewed 41 studies (n = 2,855) evaluating high-frequency repetitive transcranial magnetic stimulation (HF-rTMS) on activities of daily living of patients with post-stroke cognitive impairment. Overall, all included studies reported significant improvements in Barthel Index or modified Barthel index on activities of daily living following HF-rTMS. Controlling for heterogeneity, subgroup analysis of HF-rTMS 4 week duration: Barthel Index scores (5 studies, n = 332) showed significant improvements in the intervention (MD =8.98, 95% CI: 7.50 to 10.45) compared to the control; and similarly, Modified Barthel Index scores (10 studies, n = 859) were significantly improved in the intervention (MD = 8.92, 95% CI: 6.56 to 11.29) compared to control.

Chen et al (2023) *[519]* reviewed 12 studies (n = 639) evaluating the effects of non-invasive brain stimulation in improving limb motor function and activities of daily living in acute stroke. Barthel Index scores (8 studies, n = 330) showed a significant improvement in activities of daily living in low-frequency and/or high-frequency repetitive transcranial magnetic stimulation (rTMS) interventions (MD = 12.29; 95% CI: 4.93 to 19.66) compared to control.

Further trials with larger sample sizes, different settings and long-term outcomes are needed to inform clinical practice.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Repetitive transcranial magnetic stimulation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
ADL [1] Post intervention 8 Critical	Measured by: Barthel Index or FIM High better Based on data from 241 participants in 3 studies. (Randomized controlled) Follow up: End of intervention (2-4 weeks).	Difference:	**SMD 1.16 higher** (CI 95% 0.17 higher — 2.15 higher)	**Low** Moderate risk of bias, serious inconsistency, serious imprecision [2]	Repetitive transcranial magnetic stimulation may improve ADL

1. Measures of ADL, such as Barthel Index, Functional Independence Measure
2. **Risk of Bias: no serious.** Unclear concealment in two trials. One trial had unblinded participants/personnel.

Inconsistency: serious. The magnitude of statistical heterogeneity was high, with I^2:91%.. **Indirectness: no serious.**

Imprecision: serious. Wide confidence intervals, Low number of patients. **Publication bias: no serious.** Asymmetrical funnel plot noted in Cochrane Review. One additional trial now identified and included..

Attached Images

Communication difficulties

In Australia, communication and speech problems occur in approximately 620% of stroke patients on admission (Stroke Foundation 201915 *[7]*). UK data suggest that one-third of people are left with communication disability after stroke (Bowen et al. 2012 *[318]*). Considering its impacts on stroke survivors' functional performance and psychological wellbeing, appropriate assessments and treatments should be provided.

Assessment of communication deficits

Info Box

Practice point

- All stroke survivors should be screened for communication deficits using a screening tool that is valid and reliable.
- Those stroke survivors with suspected communication difficulties should receive formal, comprehensive assessment by a specialist clinician to determine the nature and type of the communication impairment.

Evidence To Decision

Resources and other considerations

Implementation considerations

There are clinical indicators collected in the National Stroke Audit to determine whether patients were assessed by a speech pathologist during their inpatient admission and whether this assessment took place within 48 hours of admission. Additionally, there is an organisational indicator collected in the National Stroke Audit to ascertain whether or not hospitals have locally agreed assessment protocols for communication.

Rationale

Screening is an important step because patients may otherwise be at risk of “falling through the cracks” in the health system. Patients may appear more able in general conversations than they really are, drawing on non-verbal and contextually situated cues. Aphasia is complex, is on a continuum of very severe to very mild, may affect language modalities to different degrees, and may also evolve rapidly in the early period. A formal screen is required to determine whether more detailed assessment is appropriate. A formal comprehensive assessment has multiple functions, including establishing a baseline, determining communication strengths and weaknesses, contributing information towards education and goal setting for patients and families, monitoring change, and determining rehabilitation planning.

Aphasia

The term aphasia is a communication disorder describing an acquired loss or impairment of the language system following brain damage. It differentiates from other communication difficulties attributed to sensory loss, confusion, dementia or speech difficulties due to muscular weakness or dysfunction, such as dysarthria (Brady et al. 2016 *[299]*). The most common cause of aphasia is a stroke to the left hemisphere, where the language function of the brain is usually situated for right-handed people (Brady et al. 2016 *[299]*). The National Stroke Audit showed that around a third of stroke patients (34%) had aphasia on admission (Stroke Foundation 2019 *[7]*).

There is no universally accepted treatment that can be applied to every person with aphasia, and typically therapists select from a variety of theoretical approaches, delivery models, and intervention regimens to manage and facilitate rehabilitation (Brady et al. 2016 *[299]*).

Good practice statement

Practice point
Assessment and treatment for aphasia should be offered as early as tolerated.

Strong recommendation

Updated

For stroke survivors with aphasia, speech and language therapy should be provided to improve functional communication, reading comprehension, auditory comprehension, general expressive language and written language. (RELEASE 2021 *[424]*, Brady et al. 2016 *[299]*)

Update approved by NHMRC August 2022.

Practical Info

The evidence suggests that benefits of speech and language therapy are aimed towards both impairment and functional goals. There is a range of options addressing all modalities and opportunities to transfer this work into meaningful contexts as negotiated with patients and families. Therapy options are varied but include targeting specific underlying deficits or optimising preserved abilities through, for example, phonological or semantic therapies, sentence or discourse level therapies, reading and writing. Benefits have been shown for constraint-induced language therapy, multi-modal therapy, computer-based therapies, conversation therapies, partner-training and group-based communication and psychosocial therapies.

Specific individual, aphasia and stroke profiles may interact with how a person with aphasia responds to characteristics of complex interventions such as intervention regimen, delivery model, and theoretical approach (Brady et al. 2016 *[299]*).

It is important to discuss treatment with the patient and where relevant aphasia friendly resources are provided.

The Australian Aphasia Rehabilitation Pathway (AARP) is a set of care standards for aphasia management. It has been designed for speech pathologists to help guide person-centered, evidence-based aphasia services. It aims to optimise the overall rehabilitation journey for people with aphasia and their families/friends. The AARP is available at www.aphasiapathway.com.au.

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

Overall, there appears to be a benefit of speech and language therapy (SLT) over no SLT according to a Cochrane review (Brady et al. 2016 *[299]*) based on 27 randomised controlled trial comparisons, including 1620 participants. More specifically, benefits were found on functional communication, reading, general expressive language and written language. No benefits or harms were found in auditory comprehension or naming. Other subsequent trials have reported beneficial effects on naming (Palmer et al. 2019 *[425]*) and verbal communication (Breitenstein et al. 2017*[426]*). The RELEASE study (2021)*[424]* individual patient meta-analysis reported an association of improvements from baseline in overall language ability, naming, auditory comprehension and functional communication although the association was strongest for studies with early (<1month) recruitment and younger age group (<55 years). There were no harms associated with SLT.

Certainty of the Evidence

Moderate

While the certainty of evidence for functional communication, reading comprehension, auditory comprehension and written expression were graded as moderate, it was low for general expression. The trials reviewed by Brady et al (2016) were heterogeneous, for example: in their sample sizes, time post stroke, frequency of therapy, outcome measures used and the times of follow-up assessment. There was little evidence at follow-up that benefits were long-lasting.

Values and preferences

No substantial variability expected

No variation in patient values and preferences is expected as all patients are expected to want therapy for communication problems.

Resources and other considerations

No important issues with the recommended alternative

Resources considerations

Our literature search identified three main economic evaluations of various speech and language therapies using clinical trial data (Humphreys et al. 2015 *[310]*; Bowen et al. 2012 *[302]*; Palmer et al. 2019 *[425]*). However, the results of these evaluations were uncertain either due to risk of bias, complexity of the evidence and variability shown in sensitivity analyses. Overall, there was no conclusive evidence that these therapies were cost-effective compared to usual care.

Computer-based speech and language therapy (CSLT) is a lower-cost option for delivering additional word finding therapy to patients with chronic aphasia post-stroke. The cost per quality adjusted life gain associated with CSLT compared with usual care is low, however, CSLT may be more cost-effective than usual care for patients with mild and moderate word-finding difficulties (Palmer et al. 2019 *[425]*).

Implementation considerations

There are clinical indicators collected on the types of management that patients with identified aphasia received. These types of management include alternative means of communication, phonological and semantic interventions, constraint-induced language therapy, supported conversation techniques, delivery of therapy programs via computer, and group therapy.

Rationale

The Cochrane review (Brady et al. 2016 *[299]*) included studies investigating a range of speech and language intervention types (e.g. constraint-induced therapy, group therapy, computer volunteer assisted training) with a range of dosages, intensity and timing of interventions. The estimates of effect are based on pooled results from all studies. There is no evidence that one form of speech and language therapy is superior to another.

While several studies in Brady et al. (2016) *[299]* compared early versus delayed interventions, there were no significant between group differences. Individual patient data meta-analysis data found early intervention (enrollment within the first month after stroke) was associated with the greatest mean absolute change in overall-language-ability from baseline (+19.1 points on the Western Aphasia Battery, CI [13.9–24.4]; IPD=260, 8 RCTs) (RELEASE 2021 *[424]*).

There is evidence of benefit of speech and language therapy for improving impairment as well as functional communication. In addition to treating these aspects of language, aphasia therapy is a broad term incorporating a range of other potential benefits for addressing activity, participation, personal and environmental factors which have not been fully evaluated through RCT studies. Other methodological approaches, such as single case study designs, have demonstrated benefits for a range of aspects of aphasia therapy.

Clinical Question/ PICO

Population: Adults with stroke with aphasia
Intervention: Speech and language therapy
Comparator: Control

Summary

A Cochrane review by Brady et al (2016) *[299]* included 57 randomised controlled trials (N = 3002) investigating the effects of speech and language therapy (SLT) for aphasia following stroke. Results from 27 comparisons of SLT against no SLT with 1620 participants showed that SLT significantly increased functional communication scores with a clinically significant effect size (SMD 0.28, 95% CI 0.06 to 0.49). Results from 7 trials also showed significant improvements in expressive language (SMD 1.28, 95% CI 0.38 to 2.19). The review authors rated the quality of evidence as moderate to low due to unclear randomisation and allocation concealment procedures in some trials and wide confidence intervals in some comparisons.

Palmer et al (2019)*[425]* explored computerised SLT compared to usual care or an attention control group (n=278 participants >4 months post stroke). Word finding improvement was 16.2% (95% CI 12.7 to 19.6, n= 240) higher in the computerised SLT group than usual care group and 14.4% (95% CI 10.8 to 18.1, n= 240) higher than the attention control group. No significant differences were observed in computerised SLT in functional communication measured with Therapy Outcome Measures when compared to usual care (MD -0.03, 95% CI -0.21 to 0.14, n= 240) or attention control (MD -0.01, 95% CI -0.20 to 0.18, n= 240). 40 of 45 serious adverse event were unrelated to trial activity and the remaining 5 were classified as unlikely to be related to trial activity.

Breitenstein et al (2017)*[426]* explored intensive SLT involving at least 10 hours/week of therapist led, individual or group therapy for 3 weeks, together with at least 5 hours/week of self-managed training (n=158 participants >6 months post stroke). A significant improvement in functional communication was observed at the end of the intervention for patients after intensive SLT (MD 2.61, 95% CI 1.49 to 3.72; n= 156) with a medium effect on the difference between groups (Cohen's d 0.58, p= 0.0004).

Godecke et al (2021)*[428]* explored early, intensive aphasia rehabilitation (n=246). No difference was found compared to usual care in communication recovery at 12 or 26 weeks (difference -1.8%, 95%CI -8.7 to 5). There was no difference in adverse events (p=0.72).

A recent review by The Rehabilitation and recovery of peopLE with Aphasia after StrokE (RELEASE) Collaborators (2021)*[424]* undertook an individual participant collated predictors of language recovery individual participant data (IPD) from 47 RCTs, 18 non-RCTs, 5 registries and 104 case-series/cohort studies (n= 5,550). Meta-analysis limited to the RCT studies found the largest proportion of change with SLT was observed in functional communication measured using the Aachen Aphasia Test - Spontaneous Speech Communication subscale (AAT-SSC) (median 10%, IQR 0 to 26.6%; 16 studies, n=608) and overall language ability measured with Western Aphasia Battery-Aphaisa Quotient points (WAB-AQ) (median 8.4%, IQR 1.3 to 22%; 11 studies, n= 418). Those aged under 55 years had the largest mean absolute change in overall language ability (MD 15.4, 95% CI 9.95 to 20.91; 11 studies, n= 136), auditory comprehension measured with Aachen Aphasia Test- Token Test (AAT-TT) (MD 6.1, 95% CI 3.2 to 8.9; 16 studies, n= 178), naming measured with the Boston Naming Test (MD 9.3, 95% CI 4.7 to 13.9; studies, n=103) and functional communication (MD 0.75, 95% CI 0.5 to 1.0; 14 studies, n= 147) compared to control than older age groups.

A further analysis by the Rehabilitation and recovery of peopLE with Aphasia after StrokE (RELEASE) Collaborators (2021)([443] involved 25 trials (n= 959) with data relevant to dose, intensity and frequency. Regarding dosage (total hours of therapy) there was no functional communication gains with less than 5 hours of therapy and no comprehension gains for less than 20 hours of therapy. A dose of between 20-50 hours was found to produce the highest gain in overall language (WAB-AQ 18.37,10.58 to 26.16; 4 studies, n= 31) and auditory comprehension (AAT-TT 5.23, 1.51 to 8.95; 7 studies, n=90). Improvements for functional communication were greatest for 14 to 20 therapyhours (AAT-SSC 0.94, 0.34 to 1.55; 3 studies, n= 11) followed by 20-50 hours. In terms of intensity (hours per week), there was no clear pattern of intensity with low intensity (<2 hours/week) often found to be similar or better than higher intensities for all outcomes. Regarding frequency, 5 days/week was found to produce the greatest gains in overall language (WAB-AQ14.95, 8.67 to 21.23; 6 studies, n= 194) with clinically similar gains between 3 to 5+ days/week. Similarly, functional communication gains were the greatest at 5 days/week (AAT-SSC 0.78, 0.48 to 1.09; 8 studies, n=155). Auditory comprehension gains were only observed at4 and 5 days/week, with greatest gains with SLT 4 days/week (AAT-TT 5.86,1.64 to 10.08; 4 studies, n=102]). Naming outcomes were best with up to 2 days/week but not 5+ days/week. rRegarding duration (weeks) of therapy generally there was no effect for short therapy (less than 3 weeks) for overall language and functional communication. Naming and auditory comprehension appear to require over 10 weeks of therapy.

Braley et al (2021) *[480]* conducted a trial (n = 32) comparing virtual speech, language and cognitive digital therapies (CT-R) compared to standard paper workbooks. Both intervention and control regimes were conducted remotely in participant homes for 30 minutes a day, 5 days a week, for a 10 week period, with assistance from family or caregiver. The CT-R intervention showed a significantly higher mean point change than the control (M = 6.36; p < 0.001) at end intervention, scored using the Western Aphasia Battery, Revised Aphasia Quotient (WAB-AQ).

Cao et al (2021) *[481]*reviewed five studies (n = 121) comparing virtual reality technology interventions and conventional rehabilitation therapy. Virtual reality intervention significantly reduced the severity of language impairment (SMD = 0.70; 95% CI: 0.01 to 1.39). Meta-analysis of studies measuring effects on functional communication (SMD = 0.41; 95% CI: -0.29 to 1.12), word finding (SMD = 0.42; 95% CI: -0.24 to 1.08) and repetition (SMD = 0.16; 95% CI: -0.62 to 0.94) were not significantly different between virtual reality and the control. Larger sample sizes and more studies with rigorous design are needed.

Devane et al (2022)*[482]* reviewed 14 studies (n = 229) exploring how virtual reality has been used to target language, well-being or quality of life in adults with aphasia following stroke or other acquired brain injury. All studies were exploratory and meta-analysis was not possible. 12 studies achieved positive outcomes in language impairment however virtual reality in aphasia rehabilitation described in the literature is limited and does not offer clear guidance for clinicians.

Fleming et al (2020) *[485]* conducted a trial (n = 35) addressing a gap identified in a Cochrane review (Brady et al,

2016) *[299]* , focusing on spoken language comprehension therapies compared to standard care. Results measured using Auditory Comprehension Test, showed significant improvements in the spoken language intervention (M=2%, SD=6%, t(34)=2.37, p=0.02) compared to standard care. No significant differences were reported in CAT Spoken Words or Spoken Sentences measures between intervention and standard care.

Menahemi-Falkov et al (2021) *[492]* reviewed 44 studies (n = 393) investigating individual patient outcomes and duration of therapeutic improvements post treatment in chronic aphasia. At the follow-up evaluation (M = 8.34 weeks), 70.42% of the immediate treatment responders showed maintenance of impairmentbased outcome gains and an additional 6.46% showed unclear maintenance. Within the 10 studies (22.73%) that performed evaluation beyond 12 weeks following treatment termination, 68.80% of the immediate treatment responders showed maintenance of activity/participation gains over time (M = 20.62 weeks) and 53.33% of the immediate treatment responders maintained Quality of life improvements (24 weeks).

Spaccavento et al (2021) *[497]* conducted a pilot study (n = 22) comparing computer-based to traditional therapist mediated treatment. Both groups showed significant improvements in language skills, functional communication and quality of life at end of 8-week treatment. However, the control group showed significantly more improvement in repetitive than the computer-based group. Findings suggest that computer-based treatment may be comparable to traditional therapist mediated treatment during the acute phase of aphasia recovery, however further studies are needed.

Rose et al (2022) *[498]* compared (n = 201) Constraint-Induced Aphasia Therapy Plus (CIAT-plus), Multimodality Aphasia Therapy (M-MAT) and usual community care in aphasia severity (COMPARE Trial). Immediately post intervention, there was no significant difference in aphasia severity improvement (WAB-R-AQ score) between the three groups. However, both CIAT-Plus and M-MAT groups showed significant improvements in naming (MD = 10.73; 95% CI: 7.83 to 13.63, MD = 7.49; 95% CI: 4.58 to 10.41 respectively), functional communication (MD = 4.32; 95% CI: 0.03 to 8.61, MD = 4.64; 95% CI: 0.32 to 8.95 respectively) and communication-related quality of life (MD = 0.20; 95% CI: 0.01 to 0.39, MD = 0.43; 95% CI: 0.24 to 0.62 respectively) compared with usual care. At 12 weeks post intervention, only CIAT-Plus showed a significant improvement in aphasia severity (WAB-R AQ score) compared to usual care (M = −2.39; 95% CI: −4.24 to 0.53). However, both CIAT-Plus and M-MAT showed significant improvements in naming (MD = 4.23; 95% CI: 1.30 to 7.16, MD = 4.42; 95% CI: 1.49 to 7.35 respectively) compared to usual care at 12 weeks post intervention.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Speech and language therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Functional communication Post intervention 8 Critical	Measured by: Various, e.g. WAB, ANELT, AAT, FCP High better Based on data from 376 participants in 10 studies. [1] (Randomized controlled) Follow up: various - 1 session to 12 months of treatment.	Difference:	**SMD 0.28 higher** (CI 95% 0.06 higher — 0.49 higher)	**Moderate** Due to serious risk of bias [2]	Speech and language therapy (SLT) probably provides more benefit than no SLT for functional communication outcomes in aphasia.
General expressive language Post intervention 7 Critical	Measured by: PICA (verbal subtest), Chinese Language Impairment Examination High better Based on data from 248 participants in 7 studies. [3] (Randomized controlled) Follow up: various - 1 session to 12 months of treatment.	Difference:	**SMD 1.28 higher** (CI 95% 0.38 higher — 2.19 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [4]	Speech and language therapy may improve general expressive language

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Speech and language therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Mood Post intervention 7 Critical	Based on data from 137 participants in 1 studies. [5] (Randomized controlled) Follow up: 24 weeks.	An RCT compared SLT to no SLT using the MAACL to assess mood. No significant differences were seen on the anxiety (MD: 0.40, 95% CI: -0.57 - 1.37), depression (MD: 0.70, 95% CI: -1.38, 2.78), or hostility scales (MD: -0.10, 95% CI: -0.90, 0.70).		**Low** Due to serious imprecision, Due to serious risk of bias [6]	speech and language therapy may have little or no difference on mood (anxiety, depression or hostility)

1. Systematic review [299] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. Systematic review [299] . **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Wide confidence intervals. **Publication bias: no serious.**
5. Systematic review [299].
6. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Wide confidence intervals, Only data from one study. **Publication bias: no serious.**

Attached Images

Strong recommendation

Updated

For stroke survivors with aphasia, early aphasia therapy, starting within the first 4 weeks post stroke should be provided to maximise language recovery (RELEASE et al. 2021*[424]*).

Update approved by NHMRC August 2022.

Practical Info

Early intervention should be offered where feasible, however, individual factors including concurrent illness and issues with engaging in rehabilitation must be considered (RELEASE,2021 *[424]*).

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

Speech and language therapy (SLT) starting within the first four weeks post stroke may have benefits for functional communication and for reducing the severity of the language impairment as compared to SLT enrolment after one month post onset. This evidence is based on one key review including 47 RCTs for overall language ability, auditory comprehension, naming and functional communication (RELEASE et al 2021. *[424]*).

Certainty of the Evidence

Low

The quality of evidence was identified as low due to risk of bias and imprecision.

Values and preferences

No substantial variability expected

There is little variability expected with therapy commencing within 4 weeks of stroke onset and preference would be not to delay therapy.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

Data pooled from multiple randomised studies, found clear association of benefits for improved communication across a range of language domains with early (within four weeks) recruitment into trials of speech and language therapy. All groups in the VERSE trial were also found to improve significantly from baseline supporting early therapy (Godecke et al. 2020 *[428]*). Significant although smaller associations were found for therapy provided in studies recruiting patients in the subacute (>1 month to <6 months) and chronic (>6 months) phases.

Clinical Question/ PICO

Population: Adults with stroke with aphasia
Intervention: Early aphasia therapy (<1 month post-onset)
Comparator: Usual care

Summary

A review by The Rehabilitation and recovery of peopLE with Aphasia after StrokE (RELEASE) Collaborators (2021*[424]*) collated predictors of language recovery individual participant data (IPD) from 47 RCTs, 18 non-RCTs, 5 registries and 104 case-series/cohort studies (n= 5,550). Meta-analysis with the RCT studies found enrolment <1 month post-onset yielded greater improvement for each of the language domains (overall language ability: MD 19.1, 95% CI 13.9 to 24.4; 8 studies, n= 260; auditory comprehension: MD 5.3, 95% CI 1.7 to 8.8; 6 studies, n= 139; naming: MD 11.1, 95% CI 5.7 to 16.5; 5 studies, n= 129; function communication: MD 1.0, 95% CI 0.7 to 1.4; 6 studies, n= 232) than those enrolled at 1 to 3 months, 3 to 6 months and >6 months.

In addition, Godecke et al (2021)*[428]* explored early, intensive aphasia rehabilitation (n=246). Whilst significant improvement occurred in all groups compared to baseline, no difference was found between usual care (average 2.3 hrs per week) and two higher intensity groups (average 5 hrs per week) in communication recovery at 12 or 26 weeks (difference -1.8%, 95%CI -8.7 to 5). There was no difference in adverse events (p=0.72).

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Early aphasia therapy (<1 month post-onset)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Overall language ability First follow up (median 10 weeks, IQR [3-26])	Measured by: Western Aphasia Battery-AQ points Scale: 0 — 100 High better Based on data from 260 participants in 8 studies.	Difference:	**MD 19.1 higher** (CI 95% 13.9 higher — 24.4 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [2]	Early aphasia therapy (<1 month post-onset) may improve overall language ability

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Early aphasia therapy (<1 month post-onset)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
7 Critical	[1] (Randomized controlled)				
Auditory comprehension First follow up (median 10 weeks, IQR [3-26]) 7 Critical	Measured by: AAT Token Test Scale: 0 — 50 High better Based on data from 139 participants in 6 studies. [3] (Randomized controlled)	Difference:	**MD 5.3 higher** (CI 95% 1.7 higher — 8.8 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [4]	Early aphasia therapy (<1 month post-onset) may improve auditory comprehension
Naming First follow up (median 10 weeks, IQR [3-26]) 7 Critical	Measured by: Boston Naming Test Scale: 0 — 60 High better Based on data from 129 participants in 5 studies. [5] (Randomized controlled)	Difference:	**MD 11.1 higher** (CI 95% 5.7 higher — 16.5 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [6]	Early aphasia therapy (<1 month post-onset) may improve naming.
Functional communication First follow up (median 10 weeks, IQR [3-26]) 7 Critical	Measured by: AAT Spontaneous Speech Communication subscale Scale: 0 — 5 High better Based on data from 232 participants in 6 studies. [7] (Randomized controlled)	Difference:	**MD 1 higher** (CI 95% 0.7 higher — 1.4 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [8]	Early aphasia therapy (<1 month post-onset) may improve functional communication.

1. Systematic review [424] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.** Risk of bias of individual studies no fully published, only described.
3. Systematic review [424] . **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.** Risk of bias of individual studies no fully published, only described.
5. Systematic review [424] . **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.** Risk of bias of individual studies no fully published, only described.
7. Systematic review [424] . **Baseline/comparator:** Control arm of reference used for intervention.
8. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.** Risk of bias of individual studies no fully published, only described.

Attached Images

Weak recommendation

Updated

For stroke survivors in the acute phase (up to six weeks post stroke onset), language therapy sessions (direct time on task) ranging between 30-45 minutes, two-three days per week may be provided from stroke onset to week 6 post stroke, with additional therapy sessions during this acute phase being unlikely to yield any further benefit to language recovery (Godecke et al. 2020 *[428]*; RELEASE Collaboration 2021 *[443]*).

Update approved by NHMRC August 2022.

Practical Info

Some trials have found higher intensity therapy has led to higher drop out rates, therefore, clinicians need to be sensitive to the tolerance level of each patient and the choice/fit of the therapy adopted. Recommended therapy time is the therapy specific dose and does not include aspects such as case management, counselling and education and rapport building.

Therapy may be delivered in both individual or group settings.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

The VERSE trial found more intensive therapy did not produce additional benefits than usual care during acute phase, with both groups making similar improvements from baseline. Similarly the RELEASE Collaboration whichincluded pooled participant data with mean time post onset of 8 weeks (range 1 week to 70 weeks)found lower intensity therapy (≤2 hours per week) leads to similar or superior effects compared to to higher intensities.

Certainty of the Evidence

Moderate

Overall quality of evidence is moderate.

Values and preferences

Substantial variability is expected or uncertain

The timing of intervention after stroke may influence tolerance to high intensity treatment, with higher dropout rates with treatments that were provided to patients earlier post stroke (Brady et al. 2016 *[299]*; Nouwens et al 2017*[427]*). Specific individual, aphasia and stroke profiles may also influence outcomes. Given the similar outcomes for various intensities it is expected that most people with stroke would be satisfield with a slightly lower intensity in the acute and subacute phase of recovery, however it is also acknowledged some individuals who have language deficits as their primary concern post stroke may desire more frequent therapy.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified. Lower intensity therapy potentially requires less direct staff time which may be an important consideration.

Rationale

Previously the Cochrane review (Brady et al 2016 *[299]*) indicated more intensive therapy may be beneficial, especially in the acute phase. However, individual patient meta-analysis (RELEASE Collaborators *[21][443]*) involving 25 studies (n=959) found lower intensity therapy (≤2 hours) resulted in the highest or similar gains in functional communication, overall language, auditory comprehension and naming. Subsequent evidence from the VERSE trial confirmed that more intensive therapy does not seem to produce additional benefits than usual care during the acute phase. Therefore, this recommendation is based on care provided in the usual care group (Godecke et al 2020 *[428]*) which aligns with the RELEASE Collaborators study (2021 *[443]*).

Clinical Question/ PICO

Population: Adults with stroke with aphasia
Intervention: High intensity speech and language therapy
Comparator: Low intensity language and speech therapy

Summary

A Cochrane review by Brady et al (2016) *[299]* included 57 randomised controlled trials (N = 3002) investigating the effects of speech and language therapy (SLT) for aphasia following stroke. The review included 38 comparisons of different forms of SLT. Meta-analysis showed significantly better functional communication when therapy was delivered at a higher intensity(MD 11.75; n=84, 2 studies, low quality) or for a longer duration (SMD 0.81; n=50, 2 studies, very low quality).

The Rehabilitation and recovery of peopLE with Aphasia after StrokE (RELEASE) Collaborators (2021)*[443]* undertook an individual participant data network meta-analysis with 25 trials (n= 959). Overall language gains were the greatest with ≤ 2 hours/week (Western Aphasia Battery -Aphasia Quotient gains15.85, [8.06 to- 23.64; 11 studies, n= 482 overall, 3 datasets, n=72) with similar gains 3 to 4 hours/week (15.80) and 9+ hours/week (15.64). Functional communication gains were the greatest with ≤ 2 hours/week (Aachen Aphasia Test -Spontaneous Speech Communication 0.77, [0.36 to- 1.19; 14 studies, n= 533, 4 datasets, n=83) with clinically equivalent gains to other intensities (AAT-SSC gains 0.53 to 0.76). Auditory comprehension gains were greatest for 9+ hours/week, ≤ 2 hours/week and 3-4 hours/week (Aachen Aphasia Test -Token Test gains 7.30, 6.50 and 6.01 respectively. Naming improved most across lower intensities (Boston Naming Test gains 13.83 ≤ 2 hours/week; 3-4 hours/week 9.70). Higher intensities did not have gains in naming.

Godecke et al (2021)*[428]* explored early, intensive aphasia rehabilitation (n=246). No difference was found between usual care (average 2.3 hrs per week) and two higher intensity groups (average 5 hrs per week) in communication recovery at 12 or 26 weeks (difference -1.8%, 95%CI -8.7 to 5). There was no difference in adverse events (p=0.72).

Outcome Timeframe	**Study results and measurements**	**Comparator** Low intensity language and speech therapy	**Intervention** High intensity speech and language therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Functional communication Post intervention	Measured by: Functional Communication Profile High better Based on data from 84 participants in 2 studies. (Randomized controlled) Follow up: High intensity - 4 weeks of treatment, Low intensity - 4 to 50 weeks.	Difference:	**MD 11.75 higher** (CI 95% 4.09 higher — 19.4 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [1]	high intensity speech and language therapy may improve functional communication
Severity of language impairment [2] Post intervention	Measured by: Various - WAB Aphasia Quotient, AAT, BDAE High better Based on data from 187 participants in 5 studies. [3] (Randomized controlled)	Difference:	**SMD 0.38 higher** (CI 95% 0.07 higher — 0.69 higher)	**Moderate** Due to serious risk of bias, Drop outs in higher intensity groups [4]	high intensity speech and language therapy may reduce severity of language impairment but the benefit is only in those who were earlier post onset (up to 3 months post stroke).

1. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
2. Looked at in 7 trials using a range of measures such as the WAB, AAT or the BDAE. Groups that received high intensity SLT did better on measures of severity of aphasia than those who received low intensity SLT (P = 0.02, SMD0.38, 95%CI

0.07 to 0.69). The evidence for this is better in those who were earlier post onset (up to 3 months post stroke) and was not found in those who were several years post stroke.
3. Systematic review. **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [299],
4. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Low number of patients.

Attached Images

Clinical Question/ PICO

Population: Adults with stroke with aphasia
Intervention: Early aphasia therapy (<1 month post-onset)
Comparator: Usual care

Summary

A review by The Rehabilitation and recovery of peopLE with Aphasia after StrokE (RELEASE) Collaborators (2021*[424]*) collated predictors of language recovery individual participant data (IPD) from 47 RCTs, 18 non-RCTs, 5 registries and 104 case-series/cohort studies (n= 5,550). Meta-analysis with the RCT studies found enrolment <1 month post-onset yielded greater improvement for each of the language domains (overall language ability: MD 19.1, 95% CI 13.9 to 24.4; 8 studies, n= 260; auditory comprehension: MD 5.3, 95% CI 1.7 to 8.8; 6 studies, n= 139; naming: MD 11.1, 95% CI 5.7 to 16.5; 5 studies, n= 129; function communication: MD 1.0, 95% CI 0.7 to 1.4; 6 studies, n= 232) than those enrolled at 1 to 3 months, 3 to 6 months and >6 months.

In addition, Godecke et al (2021)*[428]* explored early, intensive aphasia rehabilitation (n=246). Whilst significant improvement occurred in all groups compared to baseline, no difference was found between usual care (average 2.3 hrs per week) and two higher intensity groups (average 5 hrs per week) in communication recovery at 12 or 26 weeks (difference -1.8%, 95%CI -8.7 to 5). There was no difference in adverse events (p=0.72).

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Early aphasia therapy (<1 month post-onset)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Overall language ability First follow up (median 10 weeks, IQR [3-26]) 7 Critical	Measured by: Western Aphasia Battery-AQ points Scale: 0 — 100 High better Based on data from 260 participants in 8 studies. [1] (Randomized controlled)	Difference:	**MD 19.1 higher** (CI 95% 13.9 higher — 24.4 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [2]	Early aphasia therapy (<1 month post-onset) may improve overall language ability
Auditory comprehension First follow up (median 10 weeks, IQR [3-26]) 7 Critical	Measured by: AAT Token Test Scale: 0 — 50 High better Based on data from 139 participants in 6 studies. [3] (Randomized controlled)	Difference:	**MD 5.3 higher** (CI 95% 1.7 higher — 8.8 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [4]	Early aphasia therapy (<1 month post-onset) may improve auditory comprehension

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Early aphasia therapy (<1 month post-onset)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Naming First follow up (median 10 weeks, IQR [3-26]) 7 Critical	Measured by: Boston Naming Test Scale: 0 — 60 High better Based on data from 129 participants in 5 studies. [5] (Randomized controlled)	Difference:	**MD 11.1 higher** (CI 95% 5.7 higher — 16.5 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [6]	Early aphasia therapy (<1 month post-onset) may improve naming.
Functional communication First follow up (median 10 weeks, IQR [3-26]) 7 Critical	Measured by: AAT Spontaneous Speech Communication subscale Scale: 0 — 5 High better Based on data from 232 participants in 6 studies. [7] (Randomized controlled)	Difference:	**MD 1 higher** (CI 95% 0.7 higher — 1.4 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [8]	Early aphasia therapy (<1 month post-onset) may improve functional communication.

1. Systematic review [424] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.** Risk of bias of individual studies no fully published, only described.
3. Systematic review [424] . **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.** Risk of bias of individual studies no fully published, only described.
5. Systematic review [424] . **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.** Risk of bias of individual studies no fully published, only described.
7. Systematic review [424] . **Baseline/comparator:** Control arm of reference used for intervention.
8. **Risk of Bias: serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.** Risk of bias of individual studies no fully published, only described.

Attached Images

Weak recommendation

New

For stroke survivors with chronic aphasia (>6 months post stroke onset), intensive aphasia therapy (at least 10 hours/week of therapist led, individual or group therapy for 3 weeks, together with 5 hours or more, per week of self-managed training) may be used to improve aphasia. (Breitenstein et al. 2017 *[426]*)

Update approved by NHMRC August 2022.

Practical Info

Significant results from Breienstein et al 2017 included at least 10 hours per week of therapist led individual or group therapy

over three weeks in addition to at least 5 hours a week of self-management training. Treatment combined linguistic and communicative-pragmatic approaches individualised to each participant delivered by a speech therapist via individual or group therapy, while self-management training was mostly computer based. The trial included participants with a range of aphasia types and severities and ages up to 70 years.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Speech and language therapy (SLT) offered at high intensity in patients more than 6 months post stroke significantly improved functional communication in one large trial (Breitenstein et al 2017*[426]*).

Certainty of the Evidence

Moderate

Overall quality was moderate with results based primarily on one study.

Values and preferences

Substantial variability is expected or uncertain

It is expected that most people would want to trial therapy in this phase, however, some people may find the amount of practice difficult to manage depending on their individual circumstances.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

One large trial found three weeks of intensive therapy improved functional communication in those with chronic aphasia (Breitenstein et al 2017*[426]*).

Clinical Question/ PICO

Population: Adults with stroke with aphasia
Intervention: Aphasia therapy commenced >6 months post-onset
Comparator: Usual care

Summary

Breitenstein et al (2017)*[426]* explored intensive SLT involving at least 10 hours/week of therapist led, individual or group therapy for 3 weeks, together with at least 5 hours/week of self-managed training (n=158 participants >6 months post stroke). A significant improvement in functional communication was observed after 3 weeks after intensive SLT (MD 2.61, 95% CI 1.49 to 3.72; n= 156) with a moderate effect size (Cohen's d 0.58, p= 0.0004). Linguistic screening measures and patient reported quality of life was also significantly improved. The median amount of therapy was just over 30 hours over 3 week period in the intense intervention group while the control group received an average of 4.5 hours of therapy during deferred period. Both groups continued to receive a median of 1 hour of therapy during the 6 month follow up with no significant treatment effect found.

A review by The Rehabilitation and recovery of peopLE with Aphasia after StrokE (RELEASE) Collaborators (2021*[424]*) collated predictors of language recovery individual participant data (IPD) from 47 RCTs, 18 non-RCTs, 5 registries and 104 case-series/cohort studies (n= 5,550). Meta-analysis with the RCT studies found enrolment <1 month post-onset yielded greater improvement for overall language ability (Western Aphasia Bettery -AQ points): MD 19.1, 95% CI 13.9 to 24.4; 8 studies, n= 260) followed by patients enrolled 1-3 months after stroke onset (16.2 points; 6 studies, n=64); then those enrolled 3-6 months (9.6 points; 3 studies, n=16) and >6months (8.2 points; 4 studies, n=142).

Palmer et al (2019)*[425]* explored computerised SLT compared to usual care or an attention control group (n=278 participants >4 months post stroke). Word finding improvement was 16.2% (95% CI 12.7 to 19.6, n= 240) higher in the

computerised SLT group than usual care group and 14.4% (95% CI 10.8 to 18.1, n= 240) higher than the attention control group. No significant differences were observed in computerised SLT in function communication measured with Therapy Outcome Measures when compared to usual care (MD -0.03, 95% CI -0.21 to 0.14, n= 240) or attention control (MD -0.01, 95% CI -0.20 to 0.18, n= 240). 40 of 45 serious adverse event were unrelated to trial activity and the remaining 5 were classified as unlikely to be related to trial activity.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Aphasia therapy commenced >6 months post-onset	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Overall language ability [1] 3 weeks 7 Critical	Measured by: Amsterdam–Nijmegen Everyday Language Test A-scale Scale: 0 — 50 High better Based on data from 158 participants in 1 studies. [2] (Randomized controlled) Follow up: 3 weeks.	(Mean) Difference:	**SMD 0.58 higher** CI 95%	**Moderate** Due to serious imprecision [3]	Early aphasia therapy (<1 month post-onset) may improve overall language ability

1. Amsterdam–Nijmegen Everyday Language Test A-scale
2. Primary study[426]. **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: no serious.** Blinding not able due to double assessment of baseline for one group.. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Only data from one study. **Publication bias: no serious.** Risk of bias of individual studies no fully published, only described.

Attached Images

Weak recommendation against

Updated

Brain stimulation (transcranial direct current stimulation or repetitive transcranial magnetic stimulation), with or without traditional aphasia therapy, is not recommended in routine practice for improving speech and language function in chronic patients with aphasia and only used as part of a research framework. (Elsner et al. 2019 *[301]*; Hong et al. 2021*[430]*)

Update approved by NHMRC August 2022.

Practical Info

For those clinicians currently researching the application of tDCS or rTMS with or without traditional aphasia therapy, a focus on both formal outcome measures of functional communication or language impairment is important, as well as follow-up measures to assess for maintenance of any gains.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Transcranial direct current stimulation (tDCS) plus speech language therapy does not improve functional communication but may improve the accuracy of naming nouns (Elsner et al. 2019 *[301]*). No adverse events were reported and the rate of dropouts was comparable between those receiving tDCS and those receiving sham tDCS (Elsner et al. 2019 *[301]*).

Low-frequency repetitive transcranial magnetic stimulation (rTMS) in combination with speech and language therapy appears to improve language performance, naming, writing and comprehension (Hong et al 2021 *[430]*). Two out of eight studies reported adverse events (dizziness and dull pain) which were not severe.

Certainty of the Evidence

Low

Only three studies on tDCS used formal measures of functional communication or language impairment, which are more critical outcomes. Included studies also had small sample sizes and high risk of bias.

All seven trials of rTMS were randomised, prospective placebo-controlled studies but used impairment outcome measures only. Six of the seven studies did not investigate treatment effects beyond 15 weeks.

Values and preferences

Substantial variability is expected or uncertain

Given the uncertainty in the overall benefit, it is expected that some variation in patients' preferences may exist in this experimental approach to treatment.

Resources and other considerations

Important issues, or potential issues not investigated

No studies comparing cost-effectiveness were found. Brain stimulation requires equipment and skills/experience of users which is not currently considered part of normal clinical care.

Rationale

There is growing evidence-base for brain stimulation, particularly repetitive transcranial magnetic stimulation, plus speech language therapy compared to speech language therapy alone (Elsner et al. 2019 *[301]*; Hong et al 2021*[430]*). However, further high-quality research with longer follow-up and communication outcomes is required in this area before routine use in clinical care would be recommended.

Clinical Question/ PICO

Population: Adults with stroke with aphasia
Intervention: Repetitive Transcranial Magnetic Stimulation
Comparator: Sham

Summary

A systematic review by Hong et al (2021)*[430]* on low-frequency rTMS for improving language recovery in stroke patients with aphasia included 14 trials with a total of 374 participants. For one of the studies reported in this review, the authors had a number of papers retracted due to scientific fraud (Barwood et al. 2013*[429]*). Even though the Barwood et al. (2013)*[429]* article has not been retracted or have a reader alert, we are unsure if investigations into the article has occurred. The study was not removed in the meta-analysis of the review but its removal would likely not change the effect size greatly. All trials targeted the triangular part of the right inferior frontal gyrus with one study additionally investigating the stimulation of the right superior temporal gyrus. 12 studies used 1 Hz rTMS at 90% of the resting motor threshold, 1 study 1 Hz rTMS at 100% of the resting motor threshold and the last study used 1 Hz rTMS at 80% of the resting motor threshold. In 13 trials patients also received speech and language therapy following rTMS. Control participants received sham stimulation. Meta-analysis showed significant improvements in language performance post intervention (SMD 0.65, 95% CI 0.43 to 0.86) and the effect size did not change significantly when

any one trial was removed. A moderate effect was still present at follow up (2 months to 15 weeks; SMD 0.46, 95% CI 0.16 to 0.77; 5 studies, n= 170). Naming (SMD 0.53, 95% CI 0.31 to 0.75; 13 studies), repetition (SMD 0.44, 95% CI 0.20 to 0.67; 11 studies), writing (SMD 0.74, 95% CI 0.31 to 1.16; 4 studies) and comprehension (SMD 0.45, 95% CI 0.22 to 0.68; 11 studies) scales also showed significant improvement although effects for repetition and comprehension was under the clinically important thresholds. Some trials were identified to have high risk of bias and only 4/14 were deemed low-risk in each of the assessment items.

Ding et al (2022) *[483]* reviewed 69 studies (n = 1,670) comparing eight non-invasive brain stimulation interventions and their effects across different language domains and the influence of targeted location. Results with significant effects in favour of intervention compared to placebo; Low-frequency (LF)-transcranial magnetic stimulation (rTMS) (SMD = 0.84; 95% CI: 0.65 to 1.03, 24 studies, n=340) was superior to anodal transcranial direct-current stimulation (tDCS) (SMD = 0.38; 95% CI: 0.05 to 0.71, 9 studies, n=93) for improving global severity. Dual and anodal tDCS outperform rTMS (dual: 1.11, 95% CI: 0.40 to 1.81, 5 studies, n=55; anodal: 0.67, 95% CI: 0.34 to 1.01,20 studies, n=258; LF-rTMS: 0.58, 95% CI: 0.28 to 0.89,24 studies, n=378) for naming and repetition (dual: 1.50, 95% CI: 0.82 to 2.16,4 studies, n=48; anodal: 0.54, 95% CI: 0.02 to 1.06,7 studies, n=71; LF-rTMS: 0.53, 95% CI: 0.23 to 0.82, 19 studies, n=264). Anodal tDCS was ranked as the top intervention with significant effects, for spontaneous speech (SMD 1.06; 95% CI: 0.49 to 1.64, 8 studies, n=85), followed by dual tDCS (SMD 1.05; 95% CI: 0.22 to 1.87, 4 studies, n=42) and LF-rTMS (SMD 0.78; 95% CI: 0.42 to 1.15, 20 studies, n=289) respectively. Significant effects were also found in comprehension outcomes for LF-rTMS (SMD = 0.52; 95% CI: 0.23 to 0.81, 20 studies, n=275) only.

Gholami et al (2022) *[486]* reviewed 11 studies (n = 242) evaluating transcranial magnetic stimulation (rTMS) compared to sham rTMS on language outcomes. rTMS demonstrated significant effect size (0.52, p = 0.001) for the naming subtest, compared to the control. A significant effect of rTMS intervention was reported on the overall severity of aphasia (SMD =1.26, 95% CI: =0.80 to 1.71), compared to sham rTMS. No included patients reported adverse effects from intervention.

Kielar et al (2022) *[489]* reviewed 24 studies (n = 567) examined the effectiveness of repetitive transcranial magnetic stimulation (rTMS). Pooled analysis reported a significant medium effect size for rTMS (SMD = 0.655; 95% CI: 0.481 to 0.830) compared to sham rTMS. Subgroup analysis showed the strongest significant effects were observed for naming (SMD = 0.677; 95% CI: 0.443 to 0.910, 20 studies, n=463), followed by speech production (SMD = 0.569, 95% CI: 0.242 to 0.896, 10 studies, n=225), repetition (SMD = 0.586, 95% CI: 0.305 to 0.867, 14 studies, n=324) and comprehension (SMD = 0.452; 95% CI: 0.173 to 0.731, 14 studies, n=333). Results indicate that significant language improvements can be observed for up to 12 months with 10-15 sessions of 1-Hz rTMS 20-40 minutes/day over right Brodmann's area 45 (BA45). In subacute aphasia, low frequency rTMS over right BA45 improved naming, repetition, speech fluency and writing but not comprehension, whereas in chronic aphasia naming and speech production improved, but repetition and comprehension showed smaller gains.

Lee et al (2022) *[490]* conducted a trial (n = 26) examining brain activations associated with language recovery during repetitive transcranial magnetic stimulation (rTMS) compared to sham rTMS, using resting-state functional magnetic resonance imaging (rsf-MRI). Outcomes were scored using the Concise Chinese Aphasia Test (CCAT). After intervention, language function was higher than in the control group (CCAT score p = 0.014). CCAT scores in subgroup analysis showed conversation (p = 0.012), description (p = 0.006) and expression (p = 0.003) were higher in the intervention than the control group. rsf-MRI showed that enhanced clusters of spontaneous neural activity in the frontotemporal region (right superior temporal gyrus, right dorsolateral prefrontal gyrus, insular cortex, and caudate nucleus) were significantly correlated with language function improvements.

Zhang et al (2021) *[499]* reviewed 28 studies (n = 1,287) evaluating the effects and safety of repetitive transcranial magnetic stimulation (rTMS) on aphasia in stroke patients. rTMS significantly improved naming (SMD = 0.53; 95% CI: 0.30 to 0.76), repetition (SMD = 0.56; 95% CI: 0.30 to 0.81), comprehension (SMD = 0.85; 95% CI: 0.13 to 1.56), spontaneous speech (SMD = 0.70; 95% CI: 0.09 to 1.30) and aphasia severity (SMD = 1.11; 95% CI: 0.43 to 1.79) compared to sham rTMS. Subgroup analysis reported low-frequency and bilateral rTMS showed significant differences in naming, repetitive, comprehension and spontaneous speech, while high-frequency rTMS showed no differences. The quality of evidence for all outcomes was low or very low due to high heterogeneity and potential bias of included studies. **[This review includes 14 more and/or newer studies than current evidence Hong 2021]**

Zumbansen et al (2020) *[500]* studied (n = 63) repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) compared to sham control in subacute post-stroke aphasia (NORTHSTAR). All groups also received speech therapy. Naming was significantly improved in rTMS (M = 1.91; IQR: 0.77) compared to tDCS (M = 1.11; IQR: 1.51) and sham control (M = 1.02; IQR: 1.71). All other primary results were insignificant. The rTMS effect was driven by results approving significance in patient subgroup with intact Broca's area where non-invastive brain stimulation (NIBS) tended to improve unified aphasia score (UnAS) (M = 33.2%; IQR: 46.7) compared to sham control (M = 12.5%; IQR:7.9). Subgroup with infarcted Brocas area which improved UnAS with sham control (M = 75%, IQR:86.9) compared to NIBS (M = 12.7%; IQR: 31.7). Limitations include underpowered intention to treat (goal n = 99) and recruitment age-range and time-window parameters being extended after protocol due to low recruitment numbers, and language variability in participants.

Zumbansen et al (2022) *[501]* (n = 28) extended their 2020 NORTHSTAR trial which focused on subacute aphasia, reporting on chronic aphasia (NORTHSTAR-CA) allowing a direct comparison of the same treatment regime in different phases of aphasia recovery. Both RTMS + speech therapy and sham rTMS + speech therapy significantly improved comprehension in the subacute aphasia group compared to chronic aphasia group. At 30 day follow up, rTMS + speech therapy improved naming significantly in subacute aphasia, compared to chronic aphasia. There was no significant rTMS effect in the chronic aphasia group.

Zheng et al (2022) *[502]* studied (n = 34) repetitive transcranial magnetic stimulation (rTMS), specifically continuous theta burst stimulation (cTBS) compared to sham stimulation. Both groups received speech therapy. Language performance was significantly improved in cTBS (t = 2.773, 95% CI=1.966 to 12.162) compared to sham control. A significantly higher effect was observed on comprehension (t=2.423, 95% CI: 0.159 to 1.926) and repetition (t=2.220, 95% CI: 0.092 to 2.345) in cTBS compared to sham control. Findings indicate that cTBS of the right posterior superior temporal gyrus may improve language production.

Outcome Timeframe	**Study results and measurements**	**Comparator** Sham	**Intervention** Repetitive Transcranial Magnetic Stimulation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Language performance Post intervention 7 Critical	Measured by: Various High better Based on data from 374 participants in 14 studies. (Randomized controlled)	Difference:	**SMD 0.65 higher** (CI 95% 0.43 higher — 0.86 higher)	**Moderate** Due to serious risk of bias [1]	Repetitive transcranial magnetic stimulation may improve language performance.
Language performance Follow up (2 months to 15 weeks) 7 Critical	Measured by: Various High better Based on data from 170 participants in 5 studies. (Randomized controlled)	Difference:	**SMD 0.46 higher** (CI 95% 0.16 higher — 0.77 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [2]	Repetitive transcranial magnetic stimulation may improve long term language performance.
Naming [3] Post intervention 7 Critical	Measured by: Various: Boston Naming Test, BDAE naming subtests, AAT naming subtests, Computerized Picture Naming Test High better Based on data from participants in 13 studies. (Randomized controlled) Follow up: 2 months - 15 weeks.	Difference:	**SMD 0.53 higher** (CI 95% 0.31 higher — 0.75 higher)	**Moderate** Due to serious risk of bias [4]	Repetitive transcranial magnetic stimulation (rTMS) may improve naming.
Comprehension [5] Post intervention 7 Critical	Measured by: AAT and BDAE comprehension subtests High better Based on data from participants in 11 studies. (Randomized controlled)	Difference:	**SMD 0.45 higher** (CI 95% 0.22 higher — 0.68 higher)	**Moderate** Due to serious risk of bias [6]	Repetitive transcranial magnetic stimulation (rTMS) may improve comprehension.

Outcome Timeframe	**Study results and measurements**	**Comparator** Sham	**Intervention** Repetitive Transcranial Magnetic Stimulation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Global Severity 9 Critical	High better Based on data from 340 participants in 24 studies. [7] (Randomized controlled)	Difference:	**SMD 0.84 higher** (CI 95% 0.65 higher — 1.03 higher)	**Low** Due to serious risk of bias, Due to serious indirectness [8]	Low-frequency Repetitive transcranial magnetic stimulation may improve global severity.
Naming 9 Critical	High better Based on data from 378 participants in 24 studies. [9] (Randomized controlled)	Difference:	**SMD 0.58 higher** (CI 95% 0.28 higher — 0.89 higher)	**Low** Due to serious risk of bias, Due to serious indirectness [10]	Low-frequency Repetitive transcranial magnetic stimulation may improve naming.
Repetition 9 Critical	High better Based on data from 264 participants in 19 studies. [11] (Randomized controlled)	Difference:	**SMD 0.53 higher** (CI 95% 0.23 higher — 0.82 higher)	**Low** Due to serious risk of bias, Due to serious indirectness [12]	Low-frequency Repetitive transcranial magnetic stimulation may improve repetition.
Spontaneous speech 9 Critical	High better Based on data from 289 participants in 20 studies. [13] (Randomized controlled)	Difference:	**SMD 0.78 higher** (CI 95% 0.42 higher — 1.15 higher)	**Low** Due to serious risk of bias, Due to serious indirectness [14]	Low-frequency Repetitive transcranial magnetic stimulation may improve spontaneous speech.
Comprehension 9 Critical	High better Based on data from 275 participants in 20 studies. [15] (Randomized controlled)	Difference:	**SMD 0.52 higher** (CI 95% 0.23 higher — 0.81 higher)	**Low** Due to serious risk of bias, Due to serious indirectness [16]	Low-frequency Repetitive transcranial magnetic stimulation may improve comprehension.

1. **Risk of Bias: serious.** Only 4 out of 14 studies met low-risk bias in each item quality assessment but overall risks were low to moderate. **Inconsistency: no serious. Indirectness: no serious.** Different languages in studies. **Imprecision: no serious. Publication bias: no serious.**
2. **Risk of Bias: serious.** Only 4 out of 14 studies met low-risk bias in each item quality assessment but overall risks were low to moderate. **Inconsistency: no serious. Indirectness: no serious.** Different primary languages across studies. **Imprecision: serious.** Wide confidence intervals, Low number of patients. **Publication bias: no serious.**
3. Outcomes include: AAT naming test, Boston naming Test, BDAE naming subtest, CPNT accuracy of naming test
4. **Risk of Bias: serious.** Only 4 out of 14 studies met low-risk bias in each item quality assessment but overall risks were low to moderate. **Inconsistency: no serious. Indirectness: no serious.** Possible differences between the population studied due to different languages. **Imprecision: no serious. Publication bias: no serious.**
5. Multiple measures
6. **Risk of Bias: serious.** Only 4 out of 14 studies met low-risk bias in each item quality assessment but overall risks were low to moderate. **Inconsistency: no serious. Indirectness: no serious.** Differences between the population of interest and those studied. . **Imprecision: no serious. Publication bias: no serious.**
7. Systematic review [483] . **Baseline/comparator:** Control arm of reference used for intervention.
8. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: serious.** Differences between the intervention/comparator of interest and those studied. **Imprecision: no serious. Publication bias: no serious.**

9. Systematic review [483] . **Baseline/comparator:** Control arm of reference used for intervention.
10. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: serious.** Differences between the intervention/comparator of interest and those studied. **Imprecision: no serious. Publication bias: no serious.**
11. Systematic review [483] . **Baseline/comparator:** Control arm of reference used for intervention.
12. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: serious.** Differences between the intervention/comparator of interest and those studied. **Imprecision: no serious. Publication bias: no serious.**
13. Systematic review [483] . **Baseline/comparator:** Control arm of reference used for intervention.
14. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: serious.** Differences between the intervention/comparator of interest and those studied. **Imprecision: no serious. Publication bias: no serious.**
15. Systematic review [483] . **Baseline/comparator:** Control arm of reference used for intervention.
16. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias. **Inconsistency: no serious. Indirectness: serious.** Differences between the intervention/comparator of interest and those studied. **Imprecision: no serious. Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population:	Adults with stroke with aphasia
Intervention:	tDCS plus speech and language therapy (SLT)
Comparator:	Sham tDCS plus SLT for improving aphasia

Summary

A Cochrane review by Elsner et al (2019) *[301]* included 21 trials (N = 421) of transcranial direct current stimulation (tDCS) for improving aphasia. The included trials used both anodal and cathodal tDCS and a variety of stimulation sites, e.g. left frontal cortex, Wernicke's area or Broca's area. All trials compared active tDCS to sham stimulation. The primary outcome (functional communication) was found to have no significant effect (SMD 0.17, 95% CI -0.20 to 0.55; 3 studies, n= 112; low quality evidence). The accuracy of naming nouns was higher in the intervention group compared to control post intervention (SMD 0.42, 95% CI 0.19 to 0.66; 11 studies, n= 298; moderate quality evidence) and the effects were sustained at 6 months (SMD 0.87, 95% CI 0.25 to 1.48; 2 studies, n= 80; low quality evidence) although this effect did not remain significant in sensitivity analysis. There was no significant difference found for the naming of verbs post intervention (SMD 0.19, 95% CI -0.68 to 1.06; 3 studies, n= 21; very low quality evidence). No difference in reported dropouts and adverse events was found between the groups (OR 0.54, 95% CI 0.21 to 1.37; 15 studies, n= 345; low quality evidence). Due to the low numbers of participants and the high risk of bias in included trials, there is insufficient evidence to determine the benefits of tDCS for aphasia.

Ding et al (2022) *[483]*reviewed 69 studies (n = 1,670) comparing eight non-invasive brain stimulation interventions and their effects across different language domains and the influence of targeted location. Results with significant effects in favour of intervention compared to placebo were ranked as follows ; Low-frequency (LF)-transcranial magnetic stimulation (rTMS) (SMD = 0.84; 95% CI: 0.65 to 1.03, 24 studies, n=340) was superior to anodal transcranial direct-current stimulation (tDCS) (SMD = 0.38; 95% CI: 0.05 to 0.71, 9 studies, n=93) for improving global severity. Dual and anodal tDCS outperform rTMS (dual: 1.11, 95% CI: 0.40 to 1.81, 5 studies, n=55; anodal: 0.67, 95% CI: 0.34 to 1.01,20 studies, n=258; LF-rTMS: 0.58, 95% CI: 0.28 to 0.89,24 studies, n=378) for naming and repetition (dual: 1.50, 95% CI: 0.82 to 2.16,4 studies, n=48; anodal: 0.54, 95% CI: 0.02 to 1.06,7 studies, n=71; LF-rTMS: 0.53, 95% CI: 0.23 to 0.82, 19 studies, n=264). Anodal tDCS was ranked as the top intervention with significant effects, for spontaneous speech (SMD 1.06; 95% CI: 0.49 to 1.64, 8 studies, n=85), followed by dual tDCS (SMD 1.05; 95% CI: 0.22 to 1.87, 4 studies, n=42) and LF-rTMS (SMD 0.78; 95% CI: 0.42 to 1.15, 20 studies, n=289) respectively. Significant effects were also found in comprehension outcomes for LF-rTMS (SMD = 0.52; 95% CI: 0.23 to 0.81, 20 studies, n=275) only.

Zumbansen et al (2020) *[500]* studied (n = 63) repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) compared to sham control in subacute post-stroke aphasia. All groups also received speech therapy. Naming was significantly improved in rTMS (M = 1.91; IQR: 0.77) compared to tDCS (M = 1.11; IQR: 1.51) and sham control (M = 1.02; IQR: 1.71). All other primary results were insignificant. The rTMS effect was driven by results approving significance in patient subgroup with intact Broca's area where non-invastive brain stimulation (NIBS) tended to improve unified aphasia score (UnAS) (M = 33.2%; IQR: 46.7) compared to sham control (M = 12.5%; IQR:7.9).

Subgroup with infarcted Brocas area which improved UnAS with sham control (M = 75%, IQR:86.9) compared to NIBS (M = 12.7%; IQR: 31.7). Limitations include underpowered intention to treat (goal n = 99) and recruitment age-range and time-window parameters being extended after protocol due to low recruitment numbers, and language variability in participants.

Outcome Timeframe	**Study results and measurements**	**Comparator** Sham tDCS plus SLT for improving aphasia	**Intervention** tDCS plus speech and language therapy (SLT)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Dropouts and adverse events At end of intervention phase 7 Critical	Odds ratio 0.54 (CI 95% 0.21 — 1.37) Based on data from 345 participants in 15 studies. (Randomized controlled)	87 per 1000 Difference:	49 per 1000 **38 fewer per 1000** (CI 95% 67 fewer — 28 more)	**Low** Due to serious indirectness, Due to serious imprecision [1]	tDCS plus speech and language therapy (SLT) may have little or no difference on dropouts and adverse events post intervention.
Accuracy of naming nouns At end of intervention phase 7 Critical	Based on data from 298 participants in 11 studies. [2] (Randomized controlled)	Difference:	**SMD 0.42 higher** (CI 95% 0.19 higher — 0.66 higher)	**Moderate** Due to serious indirectness, [3]	tDCS plus speech and language therapy (SLT) probably improves accuracy of naming nouns
Accuracy of naming nouns Follow up ~6 months 7 Critical	High better Based on data from 80 participants in 2 studies. (Randomized controlled)	Difference:	**SMD 0.42 higher** (CI 95% 0.19 higher — 0.66 higher)	**Low** Due to very serious imprecision [4]	tDCS plus speech and language therapy (SLT) may improve accuracy of naming nouns long term.
Functional communication At end of intervention phase 7 Critical	Measured by: Formal outcome measures of aphasia High better Based on data from 112 participants in 3 studies. (Randomized controlled)	Difference:	**SMD 0.17 higher** (CI 95% 0.2 lower — 0.55 higher)	**Low** Due to serious imprecision, Due to serious indirectness [5]	tDCS plus speech and language therapy (SLT) may have little or no difference on functional communication post intervention
Function communication Follow up ~6 months 7 Critical	High better Based on data from 80 participants in 2 studies. (Randomized controlled)	Difference:	**SMD 0.14 higher** (CI 95% 0.31 lower — 0.58 higher)	**Very low** Due to very serious imprecision, Due to serious indirectness [6]	We are uncertain whether tDSC plus speech and language therapy (SLT) improves or worsen function communication long term.
Accuracy of naming verbs At end of	High better Based on data from 21	Difference:	**SMD 0.19 higher** (CI 95% 0.68 lower — 1.06	**Very low** Due to serious indirectness, Due	We are uncertain whether tDCS plus speech and language

Outcome Timeframe	**Study results and measurements**	**Comparator** Sham tDCS plus SLT for improving aphasia	**Intervention** tDCS plus speech and language therapy (SLT)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
intervention phase 7 Critical	participants in 3 studies. (Randomized controlled)		higher)	to very serious imprecision [7]	therapy (SLT) improves or worsen accuracy of naming verbs post intervention.

1. **Inconsistency: no serious. Indirectness: serious.** Downgraded due to the fact that the 95% CI around the pooled effect estimate includes both 1) no effect and 2) appreciable benefit or appreciable harm (an effect size of 0.5 serves as a surrogate for a minimal clinically important difference/appreciable benefit or harm). **Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
2. Systematic review [301] with included studies: Kang 2011, Monti 2008a, You 2011, Fiori 2013, Floel 2011, Marangolo 2013b. **Baseline/comparator:** Systematic review.
3. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
4. **Inconsistency: no serious. Indirectness: no serious. Imprecision: very serious.** Low number of patients. **Publication bias: no serious.**
5. **Inconsistency: no serious. Indirectness: serious.** Downgraded due to the fact that the 95% CI around the pooled effect estimate includes both 1) no effect and 2) appreciable benefit or appreciable harm (an effect size of 0.5 serves as a surrogate for a minimal clinically important difference/appreciable benefit or harm. **Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
6. **Inconsistency: no serious. Indirectness: serious.** Downgraded due to the fact that the 95% CI around the pooled effect estimate includes both 1) no effect and 2) appreciable benefit or appreciable harm (an effect size of 0.5 serves as a surrogate for a minimal clinically important difference/appreciable benefit or harm. **Imprecision: very serious.** Low number of patients. **Publication bias: no serious.**
7. **Inconsistency: no serious. Indirectness: serious.** Downgraded due to the fact that the 95% CI around the pooled effect estimate includes both 1) no effect and 2) appreciable benefit or appreciable harm (an effect size of 0.5 serves as a surrogate for a minimal clinically important difference/appreciable benefit or harm). **Imprecision: very serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Strong recommendation

New

Communication partner training should be provided to health professionals or volunteers who interact with people with aphasia after stroke. (Simmons-Mackie et al 2016 *[432]*; Finch et al 2017 *[442]*; Power et al 2020 *[439]*)

Update approved by NHMRC December 2022.

Practical Info

In regards to current communication partner training (CPT) practices, a national survey of 122 speech pathologists by Chang et al. (2018)*[435]* found that 66.1% of clinicians reported training unfamiliar CPs, such as healthcare providers with 95% of those providing CPT for aphasia specifically. 13.3% of the clinicians used evidence-based published programs with unfamiliar CPs but none strictly followed manualised protocols. Current stroke CPT is characterised by one to two sessions with less than 30 minutes to an hour of informal face-to-face education and skills training, usually when requested. Educational approaches were a common method for CPT (92%, n=69), followed by skills training approaches (80%, n=60). The main unfamiliar CPs who received training were nurses (85.3%, n=64) and allied health professionals (82.7%, n=62), and others were medical doctors, volunteers, food service staff, patient service assistants, administrative staff, paid carers and students.

No specific CPT program or delivery method has been found to be more effective than others. For example, Heard et al. (2017), found no difference between the E-Learning Plus CPT program and Supported conversation for Adults with Aphasia (SCA) CPT program in increasing health care professionals' confidence and knowledge of aphasia. (Heard et al 2017 *[437]*) Similarly, no significant difference in efficacy exists for delivery of CPT via face to face and video/telehealth and e-learning delivery formats. (Cameron et al 2019 *[438]*; Finch et al 2020 *[440]*; Power et al 2020 *[439]*)

Shrubsole et al. (2021)*[436]* undertook an implementation study which aimed to adapt CPT intervention targeting healthcare professionals with two successive groups of healthcare professionals (n= 6 and 7). Greater improvements in the second group were observed suggesting that the iterative tailoring of the intervention to the local organisational context was more successful in addressing the barriers to change and improved implementation. The authors suggest that when implementing CPT, therapists should consider using audit and feedback, physical resources and educational lectures together with interactions with people with aphasia.

Information about using relevant alternative and augmentative communication tools may also be helpful to include during CPT. (Russo et al 2017 *[457]*)

Evidence To Decision

Benefits and harms — Substantial net benefits of the recommended alternative

The majority of studies reported improvement in health professional's knowledge, confidence and use of communication strategies and benefits to stroke survivors' communication activity and participation. No harms were reported.

Certainty of the Evidence — Moderate

Results based on a small number of randomised studies. Overall certainty of evidence is moderate.

Values and preferences — No substantial variability expected

People with aphasia and their families report the importance of having trained communication partners in healthcare settings (van Rijssen et al. 2021*[455]*) Similarly, communication partners report wanting training to support their interactions with people with aphasia (Carragher et al. 2021*[454]*; Hur & Kang, 2022*[456]*).

Resources and other considerations — Important issues, or potential issues not investigated

No studies were found related to cost effectiveness or economic analysis.

Rationale

Communication partner training is a term used to describe interventions that train the conversation partner/s i.e. individuals who communicate or interact with a person with aphasia. Training health professionals (including students), and volunteers to use supportive communication strategies in their interactions with people with aphasia can benefit both people with aphasia, and their communication partners (CPs).(Simmons-Mackie et al 2016 *[432]*; Finch et al 2017 *[442]*; Power et al 2020 *[439]*) Training for partners (student/ health professionals, volunteers) can improve their (i) knowledge, (ii) attitudes/confidence, and (iii) use of supportive communication strategies when interacting with people with aphasia. Evidence currently exists for post-acute and chronic phases, while evidence for the acute context remains unclear.

Clinical Question/ PICO

Population: Adults with stroke with aphasia
Intervention: Communication partner training (CPT) with health care professional
Comparator: Usual care or no treatment

Summary

Simmons-Mackie et al. (2010)*[433]* included 31 studies, of which 2 were of RCT design and another 3 were classified as to be all other controlled design with the majority case series or individual case reports. Most studies (N=18) involved training in a group setting with ten studies involving the partner and person with aphasia. Carers or family members were the focus of most training with only two studies training volunteers and two studies training health care providers. No meta-analysis was undertaken with most studies reporting some beneficial effects. The same authors updated the review (Simmons-Mackie et al. 2016*[432]*) which included 25 additional studies (all uncontrolled studies, case series or case reports). The number of participants included was approximately 589 communication partners and 185 people with aphasia. Unlike earlier studies, most communication partners (339/454) were medical professional or health care students. Almost all the studies involved people with stroke in the post-acute and chronic phase of recovery. Considerable positive changes were noted for communication activity/participation in people with aphasia and skill and confidence of the trained partners.

Subsequent randomised studies have focused on training health professional/student partners. These include:

Finch et al. (2017 & 2018)*[441][442]* investigated the effect of communication partner training (CPT) in 38 speech-language pathology students. Training (in the form of a lecture prior to conversations) enhanced knowledge with greater amounts of communication strategies used (coefficient -0.68, 95% CI -1.16 to -0.21) and increased confidence levels (coefficient -25, 95% CI -42 to -8) for those trained compared to those who had direct conversations only.(Finch et al 2018) The trained group also received significantly higher Measure of skill in Support Conversation (MSC-reveal competence), used significantly more props and introduced significantly more new ideas into the conversation than the untrained group.(Finch 2017) No significant difference in other outcomes were found e.g. MSC acknowledging competence scores, Measure of Participation in Conversation (MPC) Interaction or Transaction scores, number of interactions, gestures, writing, minor or major conversation breakdowns, or in the success of strategies initiated to repair the conversation breakdowns.

Heard et al. (2017)*[437]* compared the effectiveness of two different CPT programs (E-Learning Plus CPT with Supported Conversations for Adults with Aphasia CPT) with 48 inpatient rehabilitation staff. Both interventions were found to produce significantly higher self-reported confidence and knowledge of aphasia (both $p < 0.001$) with no significant difference between the programs ($p = 0.88$).

Cameron et al. (2019)*[438]* compared face-to-face training (n=27) with videoconference facilities (n=28) with health professionals. Both groups improved confidence ($p<0.001$) and number of communication strategies identified with training (median 4 face-to-face vs median 3 videoconference). No difference between groups regarding confidence and number of communication strategies was observed.

Finch et al. (2020) *[440]* also completed the training via telehealth (n= 33) and found it was feasible to deliver training while also achieving statistically significant increases in self-rated confidence communicating with people with aphasia, proficiency at engaging in an everyday conversation and proficiency obtaining a case history (all $p < 0.001$) post intervention. However the total number of strategies listed by the students pre and post conversation did not differ significantly.

Power et al. (2020)*[439]* (n=30 occupational therapy students) provided an introductory 45 minutes training session delivered either online or face-to-face. A third group without training was a control group. Compared with the control group, both online and face-to-face CPT groups had significantly higher knowledge of aphasia (online vs control $p = 0.002$; face-to-face vs control $p <= 0.001$), knowledge of facilitative communication strategies (online vs control $p = 0.002$; face-to-face vs control $p <= 0.001$) and positive attitudes towards aphasia (online vs control $p = 0.031$; face-to-face vs control $p = 0.032$). No difference was found between online and face-to-face CPT delivery methods.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Communication Partner Training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Effective communication strategies	(Randomized controlled)	12 of 21 observational studies reported increase in effective communication strategies (Simmons-Mackie 2016). Subsequent RCTs by Finch et al (2017, 2018, 2020) and Cameron et al (2019) reported increase in communication strategies after training.		**Moderate** Due to serious risk of bias and small patient numbers in studies [1]	Communication partner training probably improves effective communication strategies.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Communication Partner Training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Knowledge [2]	(Randomized controlled)	Observational studies consistently reported increased knowledge after training (Simmons-Mackie et al 2016). Further randomised studies found increased knowledge (Power et al 2020, Heard et al 2017)		Moderate Due to serious risk of bias and small patient numbers in studies	Communication partner training improves knowledge.
Psychosocial adjustment/ identity [3]	(Randomized controlled)	All 5 studies reported positive changes in pscyhosocial function (e.g. self-confidence). Multiple RCTs also reported improved confidence by communication partners after training.		Moderate Due to serious risk of bias and small patient numbers in studies	Communication partner training improves self-confidence.

1. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious.** Little medium to long term data. **Imprecision: no serious.** Low number of patients.
2. Mostly self reported responses to questionnaires or interviews
3. Self-confidence, self-perceptions

Attached Images

Weak recommendation

New

Communication partner training may be provided to carers or family members of people with aphasia after stroke. (Simmons-Mackie et al 2010 *[433]*; Simmons-Mackie et al 2016 *[432]*)

Update approved by NHMRC December 2022.

Practical Info

In regards to current communication partner training (CPT) practices, a national survey of 122 speech pathologists by Chang et al. (2018)*[435]* found that 98.3% of the clinicians reported training familiar communication partners (CPs), such as spouses. 10.0% of the clinicians used evidence-based published programmes. Current stroke CPT is characterised by 1-2 <1hr sessions of informal face-to-face education and skills training. Training involved skills (94.5%) and educational approaches (91.8%) primarily, with counselling also utilised (63.6%). In addition to spouses and family, other family communication partners included friends, employers, community members and regular care providers.

Skill based CPT with familiar partners may include experiential learning, video-feedback and instructions, role-plays and home assignments with examples from conversations they have with the person with aphasia and building insight regarding the two-way nature of communication (e.g. Wielaert et al 2016).

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Almost all studies reported improvements on impairments, activity and participation, and psychosocial adjustment/identity for people with aphasia. Likewise, almost all studies of activity and participation, and psychosocial adjustment/identify reported improvements for communication partners. No harms were discussed.

Certainty of the Evidence

Very low

Results based on a number of non-randomised studies, individual experimental design and case studies. Overall certainty of evidence is very low.

Values and preferences

No substantial variability expected

People with aphasia and their families report a need for improved communication (Brown et al 2012; Halle & Le Dorze 2014). In general, familiar communication partners report wanting and valuing training to support their interactions with people with aphasia. (Blom Johansson et al 2012; Sorin-Peters & Paterson 2014) However, some familiar partners may not view training as a treatment priority (Blom Johansson et al 2012; Wielaert et al 2017) and there may be some differences in the optimal timing of training (i.e., earlier versus later), with the timing of training undertaken in the evidence varying between the subacute (i.e., within 3 months post stroke) (Halle & Le Dorze 2014; Wielaert et al 2017) and more chronic phase of recovery (e.g., over 6 months post stroke)(Blom Johansson et al 2012; Brown et al 2012).

Resources and other considerations

Important issues, or potential issues not investigated

No studies were found related to cost effectiveness or economic analysis.

Rationale

Communication partner training is a term used to describe interventions that train the conversation partner/s i.e. individuals who communicate or interact with a person with aphasia. Training carers or family members about aphasia and how to improve communication appears to improve measures of participation and psychosocial function for people with aphasia. Training also appears to have benefits for communication partners. The information drawn from a number of non-randomised studies. Overall, the potential beneficial effects reported and lack of perceived harms warrants consideration of this in patients in sub-acute and chronic stages of recovery. It is unclear the impacts of communication partners in the acute recovery phase.

Clinical Question/ PICO

Population: Adults with stroke with aphasia
Intervention: Communication partner training (CPT) with family/carer
Comparator: Usual care or no treatment

Summary

Simmons-Mackie et al. (2010)*[433]* included 31 studies (371 partners). No studies of familiar partners were randomised-controlled trials with most being case series or individual case reports. Carers or family members were the focus of most training (25/31 studies representing 234 partners) with six studies involving volunteers, students or strangers (representing 118 partners). Most studies (N=18) involved training in a group setting with ten studies involving the partner and person with aphasia. No meta-analysis was undertaken with most studies reporting some beneficial effects on impairment outcomes (5/7 studies reported improvements), activity and participation outcomes (19/21 studies reported improvements but only 3 reported gains were maintained) and psychosocial outcomes (9/10 studies reported improvements and 5 reported gains were maintained) in people with aphasia. Similarly, most outcomes related to communication partners was positive from activity/participation level (21 / 22 studies) and psychosocial outcomes (8/10 studies). Almost all studies were in the post-acute and chronic phase. The same authors updated the review (Simmons-Mackie et al. 2016*[432]*) which included 25 additional studies (all uncontrolled studies, case series or case reports). The number of participants included was approximately 589 communication partners and 185 people with aphasia. Unlike earlier studies, most communication partners (339/454) were medical professional or health care students. Almost all the studies involved people with stroke in the post-acute and chronic phase of recovery. Considerable positive changes were noted for communication activity/participation in people with aphasia and skill and confidence of the trained partners.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Communication Partner Training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Language impairment [1]	[2] (Observational (non-randomized))	5/7 studies reported improvements in impairments in at least some participants with aphasia.		**Very low** Due to very serious risk of bias, Due to serious indirectness [3]	Communication partner training may improve measure of impairment for people with aphasia
Communication activity and participation [4]	[5] (Observational (non-randomized))	19/21 studies reported improvements in various measures of activity or participation of people with aphasia. Only 3 studies reported gains were maintained. All studies were in post-acute and chronic phases. For communication partners 21/22 studies reported positive outcomes for activity/participation measures, 6 studies reported gains were maintained.		**Very low** Due to very serious risk of bias, Due to serious indirectness [6]	Communication partner training may improve activity or participation outcomes for people with aphasia
Quality of Life	(Observational (non-randomized))	Only one study of communication partners involved quality of life measures. There was no significant difference reported.		**Very low** Due to very serious risk of bias, Due to serious imprecision [7]	We are unsure the impact of communication partner training on quality of life for people with aphasia
Psychosocial adjustment/ identity	[8] (Observational (non-randomized))	9 out of 10 studies reported improvements in measures of psychosocial functioning for people with aphasia. Five studies noted gains were maintained over time. For communication partners, 8/10 studies reported improvements and 3/4 noted gains were maintained.		**Very low** Due to very serious risk of bias, Due to serious indirectness [9]	Communication partner training may improve psychosocial outcomes for people with aphasia

1. Results from standard aphasia assessment batteries such as the Western Aphasia Battery.
2. Systematic review **Supporting references:** [433],
3. **Risk of Bias: very serious.** No randomised studies. Unclear blinding.. **Inconsistency: no serious. Indirectness: serious.** Different outcomes, timeframes, interventions.
4. Included standardized tests such as the Communication Activities of Daily Living,57 questionnaires or communication ratings, measures of participation in conversation, and calculations pertaining to the effectiveness of conversational discourse, often observed within the dyad with a communication partner.
5. Systematic review **Supporting references:** [433],
6. **Risk of Bias: very serious.** No randomised studies. Unclear blinding.. **Inconsistency: no serious. Indirectness: serious.** Different outcomes, timeframes, interventions.
7. **Risk of Bias: very serious. Imprecision: serious.** Only data from one study, Low number of patients.
8. Systematic review **Supporting references:** [433],
9. **Risk of Bias: very serious.** No randomisation. Unclear blinding.. **Indirectness: serious.** Different outcomes used, different time frames.

Attached Images

Info Box

Practice point
Where a stroke patient is found to have aphasia, the clinician should:

- Document the provisional diagnosis.
- Explain and discuss the nature of the impairment with the patient, family/carers and treating team, and discuss and teach strategies or techniques which may enhance communication.
- Identify goals for therapy, and develop and initiate a tailored intervention plan, in collaboration with the patient and family/carer.
- Reassess the goals and plans at appropriate intervals over time.
- Use alternative means of communication (such as gesture, drawing, writing, use of augmentative and alternative communication devices) as appropriate.

All written information on health, aphasia, social and community supports (such as that available from the Australian Aphasia Association or local agencies) should be available in an aphasia-friendly format.

Info Box

Practice point

- Stroke survivors with chronic and persisting aphasia should have their mood monitored.
- Environmental barriers facing people with aphasia should be addressed through training communication partners, raising awareness of and educating about aphasia to reduce negative attitudes, and promoting access and inclusion by providing aphasia-friendly formats or other environmental adaptations. People with aphasia from culturally and linguistically diverse backgrounds may need special attention from trained healthcare interpreters.
- The impact of aphasia on functional activities, participation and quality of life, including the impact upon relationships, vocation and leisure, should be assessed and addressed as appropriate from early post-onset and over time for those chronically affected.

Apraxia of speech

Apraxia of speech (AOS) is a disruption in spatial and temporal planning and/or programming of movements for speech production, often caused by stroke (Ballard et al. 2015 *[313]*). AOS is characterised by slowed speech rate with distorted phonemes, distorted phoneme substitutions, and a tendency to segregate speech into individual syllables and equalise stress across adjacent syllables (Ballard et al. 2015 *[313]*). It is predominantly a disorder of articulation and prosody, though it can involve all speech subsystems (Ballard et al. 2015 *[313]*). Currently, there is no randomised controlled trial in AOS, possibly due to its rarity (Ballard et al. 2015 *[313]*). The research has primarily focused on identifying effective treatments that can be replicated in a larger population, and mostly consists of single-case experimental designs, case series, and uncontrolled case studies (Ballard et al. 2015 *[313]*).

Weak recommendation

For stroke survivors with apraxia of speech, individually tailored interventions incorporating articulatory-kinematic and rate/rhythm approaches may be used. (Ballard et al. 2015 *[313]*)

In addition, therapy may incorporate (Ballard et al. 2015 *[313]*):

- Use of modelling and visual cueing.
- Principles of motor learning to structure practice sessions.
- Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT) therapy.
- Self-administered computer programs that use multimodal sensory stimulation.
- For functional activities, the use of augmentative and alternative communication modalities such as gesture or speech-generating devices is recommended.

Practical Info

Articulatory-kinematic and rate/rhythm approaches may include articulatory placement and transitioning, speech rate and rhythm, increasing length and complexity of words and sentences, and prosody including lexical, phrasal, and contrastive stress production.

Treatments were typically applied for about 28 sessions over at least 7 weeks. In this review, 14 studies using articulatory–kinematic intervention reported using specific Principles of Motor Learning (Schmidt & Lee 2011, cited in Ballard et al. 2015 *[313]*). The principles applied or tested were level of feedback frequency, timing of feedback relative to participant's response, using variable practice (i.e. stimuli varied along some dimension such as voice onset time or phonetic context) and random versus blocked stimulus presentation, and using high-complexity (consonant clusters) versus low-complexity (singletons) stimuli.

One additional principle considered beneficial for motor learning is high-intensity practice, reflected in number of practice trials per sessions and/or number of sessions per week.

Evidence To Decision

Benefits and harms — Substantial net benefits of the recommended alternative

The systematic review seems to support a strong effect for both articulatory-kinematic and rate/rhythm-based interventions (Ballard et al. 2015 *[313]*; Wambaugh et al. 2006 *[314]*). Harm was not reported in this review.

Certainty of the Evidence — Low

The overall quality of evidence is low due to small sample size and high risk of bias.

Values and preferences — No substantial variability expected

Stroke survivors with apraxia of speech would want to receive appropriate therapies, although the optimal approach remains unclear.

Resources and other considerations — No important issues with the recommended alternative

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

The quality of evidence from a systematic review (Ballard et al. 2015 *[313]*) with 26 studies (evidence from 2004–2012) was added to the existing review (Wambaugh et al. 2006 *[314]*). Overall the evidence is low, therefore a stronger recommendation cannot be made at this time. Both articulatory–kinematic and rate/rhythm-based interventions may produce changes at the impairment level (i.e. production of speech sounds in isolation, in words and syllables), but research does not yet show any transfer of training or benefits in overall communication. Studies to date have used different interventions, dosage of therapy and measures. No meta-synthesis has been completed.

Clinical Question/ PICO

Population: Stroke patients with apraxia of speech
Intervention: Articulatory–kinematic treatment
Comparator: Usual care

Summary

A systematic review of treatments for apraxia of speech (Ballard et al 2014 *[313]*) included 24 studies investigating

articulatory-kinematic treatments, all of which were within-participant experimental studies with a median sample size of 1. The review authors found that the evidence supported a strong beneficial effect of the intervention. However, the very small sample sizes and the non-randomised study designs mean that there is substantial uncertainty about the benefits of articulatory-kinematic treatment.

An earlier systematic review of treatments for apraxia of speech (Wambaugh et al 2006 *[314]*) included 59 publications, the majority of which investigated articulatory-kinematic treatments. Most studies were case studies or case series with very few participants. The review was not stroke specific but stroke was the most common aetiology. Almost all included studies (54/57) reported positive treatment effects. Again, given the study designs used and the very small numbers of participants included, there is substantial uncertainty about the possible benefits of the intervention.

A study by Varley et al (2016)*[315]* (n=50 chronic stroke participants) investigated the effectiveness of a self-administered computer therapy involving a perceptual stage (spoken word-picture matching, auditory-written word matching, and auditory lexical decision); then a production stage (observation of videos of word production, then trials requiring imagined production, followed by overt word repetition). The final stage involved more autonomous word production. Improvements were observed in naming and repetition, and were specific to trained vocabulary, with only limited transfer to phonetically similar words in repetition accuracy.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Articulatory–kinematic treatment	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Improved communication	Based on data from 95 participants in 24 studies.	There is some supporting evidence for the articulatory-kinematic approach to apraxia of speech treatment, but the evidence is weak.		Very low Small sample sizes of included studies in systematic review, and very serious risk of bias [1]	Supporting evidence for articulatory-kinematic approach to apraxia treatment, but evidence is weak.

1. **Risk of Bias: very serious.** Most studies (21/26, 81%) were classified as AAN Class III (n = 6) or III-b (n = 15), indicating evidence of internal validity (i.e., some degree of experimental control was described, allowing reasonable confidence that the reported effects were due to the application of the treatment). The remaining five studies were classified as AAN Class IV, being uncontrolled studies and/or containing no clear evidence that participants met diagnostic criteria for AOS. Of the 26 studies, 21 were judged to use some form of single-case experimental design and were scored on the SCED scale. Average SCED score was 6.6 out of 10 (SD = 2.4, range = 4–9, median = 7). Two studies were judged as group-experimental studies and were rated on the PEDro-P scale. These received scores of 7 out of 10 and 3 out of 10. Both group studies used random allocation of participants. Neither of these studies used intention to treat analyses.. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Stroke patients with apraxia of speech
Intervention: Rhythm/rate control methods
Comparator: Usual care

Summary

A systematic review of treatments for apraxia of speech (Ballard et al 2014 *[313]*) included 2 studies investigating rhythm/rate control treatments. Both were within-participant experimental studies with 1 and 10 participants. The majority of participants (8/11) included in these studies had a positive outcome, both following treatment and at follow-

up >= 2 weeks later. However, the very small sample sizes and the non-randomised study designs mean that there is substantial uncertainty about the benefits of rhythm/rate control treatment approaches.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Rhythm/rate control methods	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Improved communication 7 Critical	Based on data from 21 participants in 3 studies. (Observational (non-randomized)) Follow up: > 2 weeks follow-up.	Authors report global clinical outcomes that evidence supports an effect for rate/rhythm approach. Meta-analysis was not performed (the reason was not reported in the article). The 3 included studies had small sample sizes.		**Very low** Due to serious risk of bias, and small sample size [1]	Rhythm/rate control methods may improve communication

1. **Risk of Bias: serious.** Most studies (21/26, 81%) were classified as AAN Class III (n = 6) or III-b (n = 15), indicating evidence of internal validity (i.e., some degree of experimental control was described, allowing reasonable confidence that the reported effects were due to the application of the treatment). The remaining five studies were classified as AAN Class IV, being uncontrolled studies and/or containing no clear evidence that participants met diagnostic criteria for AOS. Of the 26 studies, 21 were judged to use some form of single-case experimental design and were scored on the SCED scale. Average SCED score was 6.6 out of 10 (SD = 2.4, range = 4–9, median = 7). Two studies were judged as group-experimental studies and were rated on the PEDro-P scale. These received scores of 7 out of 10 and 3 out of 10. Both group studies used random allocation of participants. Neither of these studies used intention to treat analyses.. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.** appears authors did a grey literature search, but not specifically stated.

Attached Images

Dysarthria

Dysarthria is an output problem, resulting from impaired movements of the speech musculature including lips, tongue, palate, larynx and respiration (Bowen et al. 2012 *[318]*). This limits intelligibility for the listener and may cause frustration and distress for the person with stroke, and often causes restricted activity and social participation (Bowen et al. 2012 *[318]*). It is unclear how prevalent dysarthria is in stroke patients, but it often co-occurs with other communication deficits that require attention from healthcare professionals (Bowen et al. 2012 *[318]*).

Weak recommendation

Updated

For stroke survivors with dysarthria, interventions tailored to the individual which include speech production tasks that target connected speech may be provided, which may include for example strategies to reduce speaking rate, emphasize articulatory placement or increased loudness (e.g., LSVT®LOUD) (Mitchell et al. 2017 *[423]*; Finch et al. 2020 *[422]*)

Update approved by NHMRC August 2022.

Practical Info

Patients with unclear or unintelligible speech should be assessed to determine the nature and cause of the speech impairment.

Dysarthria intervention should be individually tailored and should include speech practice of words and connected speech tasks

(i.e., beyond single words) including sentences and conversation, using strategies that may include slowed speaking rate, emphasis on key syllables, articulatory placement and increased loudness. Inclusion of non-speech oromotor exercises has not been shown to result in functional speech improvements (Mackenzie et al. 2014 *[317]*), and therefore is not recommended as a strategy targeting speech intelligibility. This recommendation needs to be considered in light of the small amount of research into this area and the small sample size of studies.

Dysarthria treatment should focus on functional communication use(e.g. speech production tasks used in context). Interventions for the treatment of dysarthria may include:

- biofeedback or a voice amplifier to change intensity and increase loudness
- intensive therapy aiming to increase loudness (e.g. LSVT®LOUD)
- the use of strategies such as decreased rate, emphasis on key syllables and deliberate articulation (Mackenzie et al. 2014 *[317]*) practiced using principles of motor learning (Park et al. 2016 *[445]*).
- education about the condition and training of self-management, self-monitoring, and communication partner strategies (Mackenzie et al. 2012*[444]*)

People with severe dysarthria can benefit from using augmentative and alternative communication devices in everyday activities.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

The Cochrane ~~systematic~~ review found some ~~limited~~ evidence to suggest there may be an immediate beneficial effect from dysarthria interventions on impairment level measures compared to usual care (attention control or alternative interventions). ~~, activity~~ ~~A small randomised controlled trial investigating the feasibility of non-speech oromotor exercises (NSOMEs) when added to behavioural speech production practice, provided no benefit (Mackenzie et al. 2014 *[317]*).~~

~~No h~~ H arm s w ere ~~as~~ not reported in this review ~~study~~. A further review suggested some interventions such as LSVT ®LOUD may be beneficial. Again no harms were reported.

Certainty of the Evidence

Low

Overall quality of evidence is low to very low ~~as this is based on few studies with small sample sizes~~.

Values and preferences

Substantial variability is expected or uncertain

Patients would prefer ~~an~~ early and sustained contact during their recovery. Patients value guidance, support, meeting of their individual needs and high amounts of contact during their recovery. Some individual studies ~~(e.g. Bowen et al 2012)~~ have reported high satisfaction with treatment (e.g. Bowen et al 2012) and long term improvements in participation and quality of life following dysarthria treatment(Wenke et al 2011 *[446]*) . ~~Patients are unlikely to want to receive a treatment with no proven benefits.~~

Resources and other considerations

Important issues, or potential issues not investigated

Rationale

Dysarthria interventions have been found to improve impairment-based outcomes at the end of intervention based on a small number of heterogeneous interventions. However, this is based on low and very low quality evidence from a wide range of interventions and further, adequately powered clinical studies are required (Mitchell et al 2017 *[423]*). A review which included some additional non-randomised studies indicated potential for some interventions such as LSVT®LOUD to have positive changes but again recognised the current evidence is highly heterogeneous (Finch et al. 2020 *[422]*). Overall certainty of evidence is low to very low therefore a weak recommendation is made.

Clinical Question/ PICO

Population: Stroke patients with dysarthria
Intervention: Dysarthria interventions
Comparator: Another intervention, attention control, placebo or no intervention

Summary

Mitchell et al (2017)*[423]* included 5 studies (n=234) and reviewed the effects of dysarthria interventions on people with dysarthria after stroke or brain injury. The interventions were heterogeneous and included tailored speech therapy, Lee Silverman Voice Treatment (LSVT®LOUD), non-speech oro-motor exercises, repetitive transcranial magnetic stimulation, and acupuncture. When compared to another intervention, attention control, placebo or no intervention, dysarthria intervention did not improve activity level immediately post intervention (SMD 0.29, 95% CI -0.07 to 0.66; 3 studies, n= 117; very low quality evidence) or three to nine months post intervention (SMD 0.18, 95% CI -0.18 to 0.55; 3 studies, n= 116; low quality evidence) and was consistent for persisting effect when subgroup analysis was completed specifically for patients who have had a stroke (SMD 0.16, 95% CI -0.23 to 0.54; 3 studies, n= 106; low quality evidence). A small statistically significant difference favouring the intervention was found for impairment level immediately after the intervention (SMD 0.47, 95% CI 0.02 to 0.92; 4 studies, n= 99; very low quality evidence), but no persisting effect on impairment (SMD 0.07, 95% CI -0.91 to 1.06; 2 studies, n= 56; moderate heterogeneity I^2= 70%; very low quality evidence) or participation level (SMD -0.11, 95% CI -0.56 to 0.33; 2 studies, n= 79; low quality evidence) was found for dysarthria interventions compared to any control.

Finch et al (2020) *[422]* included twenty-one mixed methods studies (n= 274) and reviewed the management of non-progressive dysarthria in adults. The review included three randomised controlled trials reporting 5 outcomes. The study population was not limited to only stroke survivors with nine studies only including participants who have had a stroke and seven studies with populations that have had stroke or traumatic brain injury. Half of the interventions involved manualised treatment program, including LSVT®LOUD, and the remaining 11 studies used a range of non-manualised tasks. Additionally, there was a lack of consistency in terms of outcomes, since no one outcome measure/s was used by the majority of the studies. From the narrative analysis, nineteen studies reported a positive effect of the intervention on at least one outcome measure, however this was found to not always be based on statistical analysis. Seven studies investigating LSVT®LOUD observed positive changes in areas such as intelligibility, loudness, hypernasality, vowel space area and articulatory precision. Overall, the authors concluded the highly heterogeneous nature of the participants meant it was not possible to determine the effect of specific interventions on particular dysarthria profiles.

Chiaramonte et al (2020) *[319]* included 25 mixed methods studies (9 RCTs) and explored the different speech therapy interventions for dysarthria. No meta-analysis was completed due to the interventions being variable in quality, intensity and duration. Further studies are needed.

Yang et al (2022) *[531]* reviewed 47 studies (n = 4,197) evaluating the efficacy of different acupuncture types and language rehabilitation. Combined acupuncture plus language rehabilitation was the most effective in treating dysarthria symptoms (OR =24.33, 95% CI: 8.92 to 66.35), followed by tongue acupuncture plus language rehabilitation (OR =14.98, 95% CI: 6.10 to 36.76) and nape acupuncture plus language rehabilitation (OR =9.71, 95% CI: 3.98 to 23.69).

Pisano et al (2021) *[532]* compared (n = 10) the effectiveness of transcranial direct current stimulation (tDCS) and transpinal direct current stimulation (tsDCS) combined with standard language training. At follow up, tsDCS improved repetition (M = 65%, p <0.001), naming verbs (M = 50%, p <0.001), naming nouns (M = 50%, p <0.001), picture description (M = 20%, p <0.001) and reading (M = 56.5%, p <0.001). Further analysis comparing tsDCS results with tDCS found no differences between the two groups.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Dysarthria interventions	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Persisting effects - activity level (non-progressive brain injury) 7 Critical	High better Based on data from 116 participants in 3 studies. [1] (Randomized controlled)	Difference:	**MD 0.18 higher** (CI 95% 0.18 lower — 0.55 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [2]	Dysarthria interventions may have little or no difference on persisting effects - activity level (non-progressive brain injury)

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Dysarthria interventions	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Persisting effects - impairment level (non-progressive brain injury) 7 Critical	High better Based on data from 56 participants in 2 studies. [3] (Randomized controlled)	Difference:	**MD 0.07 higher** (CI 95% 0.91 lower — 1.06 higher)	**Very low** Due to serious risk of bias, Due to very serious imprecision [4]	Dysarthria interventions may have little or no difference on persisting effects - impairment level (non-progressive brain injury).
Persisting effects - participation level (non-progressive brain injury) 7 Critical	High better Based on data from 79 participants in 2 studies. [5] (Randomized controlled)	Difference:	**MD 0.11 lower** (CI 95% 0.56 lower — 0.33 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [6]	Dysarthria interventions may have little or no difference on persisting effects - participation level (non-progressive brain injury)
Persisting effects - activity level (stroke subgroup) 7 Critical	High better Based on data from 106 participants in 3 studies. [7] (Randomized controlled)	Difference:	**MD 0.16 higher** (CI 95% 0.23 lower — 0.54 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [8]	Dysarthria interventions may have little or no difference on persisting effects - activity level (stroke subgroup)
Immediate effects - activity level (non-progressive brain injury) 7 Critical	High better Based on data from 117 participants in 3 studies. [9] (Randomized controlled)	Difference:	**MD 0.29 higher** (CI 95% 0.07 lower — 0.66 higher)	**Very low** Due to serious risk of bias, Due to very serious imprecision [10]	Dysarthria interventions may have little or no difference on immediate effects - activity level (non-progressive brain injury).
Immediate effects - impairment level (non-progressive brain injury) 7 Critical	High better Based on data from 99 participants in 4 studies. [11] (Randomized controlled)	Difference:	**MD 0.47 higher** (CI 95% 0.02 higher — 0.92 higher)	**Very low** Due to serious risk of bias, Due to very serious imprecision [12]	Dysarthria interventions may improve immediate effects - impairment level (non-progressive brain injury) slightly

1. Systematic review [423] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Incomplete data and/or large loss to follow up, Selective outcome reporting. **Imprecision: serious.** Low number of patients.
3. Systematic review [423] . **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of

blinding of outcome assessors, resulting in potential for detection bias, Incomplete data and/or large loss to follow up, Selective outcome reporting. **Imprecision: very serious.** Low number of patients, inadequately powered.
5. Systematic review [423] . **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Incomplete data and/or large loss to follow up. **Imprecision: serious.** Low number of patients.
7. Systematic review [423] . **Baseline/comparator:** Control arm of reference used for intervention.
8. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Incomplete data and/or large loss to follow up. **Imprecision: serious.** Low number of patients.
9. Systematic review [423] . **Baseline/comparator:** Control arm of reference used for intervention.
10. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Incomplete data and/or large loss to follow up. **Imprecision: very serious.** Low number of patients, not adequately powered.
11. Systematic review [423] . **Baseline/comparator:** Control arm of reference used for intervention.
12. **Risk of Bias: serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Incomplete data and/or large loss to follow up. **Imprecision: very serious.** Low number of patients, not adequately powered, due to [reason].

Attached Images

Cognitive communication deficits

Right hemisphere brain damage, most often caused by stroke , results in a range of cognitive communication difficulties.

Right hemisphere and/or cognitive communication disorders can be describedas an impairment in the exchange of communicative intent through nonverbal and verbal means, often at a conversational level represented by the following features (Lehman Blake et al. 2013 *[320]*) **:**

- Prosody (flat melody of speech or difficulties interpreting emotion/intent contained in another person's prosody).
- Expressive and receptive discourse (difficulties understanding intent in language that consists of two or more sentences to convey language, beyond simple words or sentences:
  - difficulties comprehending nonliteral language, including metaphors, idioms and sarcasm – problem selecting the meaning most plausible for the given context
  - difficulties producing discourse, often overpersonalised, can be impoverished or verbose – assessment can be difficult because of wide variation in healthy 'normal' population).
- Pragmatics (functional use of language in context, turn-taking adapting their communication for the social status of their communicative partner – note very little knowledge of communication partner interactions compared with left hemisphere literature).

Currently, the literature on its prevalence, assessment, and treatment is limited.

Good practice statement

Consensus-based recommendations

Stroke survivors with difficulties in communication following right hemisphere damage should have input from a suitably trained health professional including:

- a comprehensive assessment,
- development of a management plan, and
- family education, support and counselling as required. (Lehman Blake et al. 2013 *[320]*; Ferre et al. 2011 *[321]*)

Management may include:

- Motoric-imitative, cognitive-linguistic treatments to improve use of emotional tone in speech production. (Rosenbek et al. 2006 *[322]*)
- Semantic-based treatment connecting literal and metaphorical senses to improve comprehension of conversational and metaphoric concept. (Lungren et al. 2011 *[323]*)

Practical Info

An assessment of communication can be very personal and potentially confronting for a patient. Taking the time to get to know a patient (including their cultural background, interests, age, level of education etc) prior to assessing them, and keeping it in mind during the assessment, can make it a more comfortable process for them.

Potentially effective treatments at sentence level or discourse level include:

- **Prosody:** Both motoric-imitative and cognitive-linguistic treatments provided for 20 sessions each were effective in improving ability of participants to convey emotional tone (Rosenbeck et al. 2006 *[322]*). However, it is unclear which treatment was more efficacious generally, with the treatment delivered first having a slightly larger effect size.
- **Receptive language:** Lungren et al. (2011) *[323]* demonstrated that a semantic-based treatment connecting literal and metaphorical senses of concepts significantly improved the comprehension of metaphors in four participants with right stroke, three of which maintained these gains at three months follow-up.

Rationale

Overall, the small number of studies of high risk of bias and small sample size, along with the heterogeneity of treatment targets and specific outcomes, preclude strong conclusions in relation to the efficacy of treatments for cognitive communication disorders. There is some preliminary data that suggests that some people with cognitive communication disorders following stroke will benefit from treatment to improve their cognitive communication skills (including prosody and interpretation of metaphors) in the acute and chronic stages. However, further research is required.

Cognition and perception difficulties

This section provides an overview of assessment of cognitive and perceptual impairment. Specific impairments are discussed in the following sections in more detail. Cognitive and perceptual impairments include attention, memory, orientation, language, executive functions, neglect, apraxia and agnosia. Cognitive impairment is common in acute stroke, with 59~~60~~% of patients reported as having cognitive deficit on admission to rehabilitation (Stroke Foundation 2020~~14~~ *[8]*). Cognitive impairment may be missed in those who present with mild stroke and this type of impairment and can have a significant impact on life after stroke.

Advanced age, female sex, and prior stroke are associated with higher rates of cognitive impairment (Potter et al 2021 *[544]*).

Assessment of cognition

Early assessment for cognitive impairment is important. There are no universal gold-standard screening or assessment tools. If cognitive or perceptual deficits are suspected (or found on screening), a more detailed assessment (including functional assessment) conducted by a trained team member (e.g. neuropsychologist, occupational therapist or speech pathologist) can clarify the types of impairments and the impact of these impairments on function, in order to guide the team in providing the most appropriate rehabilitation interventions. Families and caregivers of stroke survivors with cognitive impairment should be provided with appropriate education and possible strategies relevant to the person's individual impairments.

Info Box

Practice points

- All stroke survivors should be screened for cognitive and perceptual deficits by a trained person (e.g. neuropsychologist, occupational therapist or speech pathologist) using validated and reliable screening tools, ideally prior to discharge from hospital.
- Stroke survivors identified during screening as having cognitive deficits should be referred for comprehensive clinical neuropsychological investigations.

Practical Info

Findings from neuropsychological testing should be discussed with the patient and family. Education and information should also be provided, verbally and in writing, about strategies which may help the person better engage in rehabilitation.

It is strongly suggested cognitive and perceptual screening should occur prior to discharge from the acute hospital.

Evidence To Decision

Resources and other considerations

Implementation considerations
There are clinical indicators collected in the National Stroke Audit on the number of patients with an identified perceptual deficit and/or cognitive deficit on admission to acute care and/or rehabilitation.

Perception

The topic of perception is complex and appears to overlap with other cognitive and sensory areas. Perceptual disorders may affect any or all of the sensory modalities. This is demonstrated in the wide range of perceptual disorders, which include visual, object, visual object agnosia, prosopagnosia, spatial, visuospatial, tactile, body, sensation, location, motion, colour processing and auditory perceptual disorders. Visual perceptual disorders are the most commonly researched (Bowen et al. 2011 *[324]*). It is important here to distinguish between deficits affecting the whole perceptual field (covered in this section) and unilateral deficits (see Neglect) or damage to the visual pathway or eye movement systems (see Vision).

The National Stroke Audit shows that at least 36% of stroke patients have a perceptual deficit on admission (Stroke Foundation 2019 *[7]*). Perceptual rehabilitation includes functional training, sensory stimulation, strategy training and task repetition (Bowen et al. 2011 *[324]*), although none have shown any measurable benefit. The impact of perceptual disorders on activities of daily

living (ADL) is varied. It can range from difficulty crossing the road (due to an impairment of distance perception) to an inability to recognise a familiar object (for example a toothbrush – object agnosia) or person's face (such as a spouse – prosopagnosia). These disorders can cause distress for the person affected and their family, and increase their dependence on others. Perceptual disorders can also hinder a person's ability to participate fully in their rehabilitation programme, for example, in their sessions with the physiotherapist or occupational therapist. Perceptual disorders can be detected using standardised assessment tools.

There is very little evidence for interventions to improve perception and further research is required.

Good practice statement

Consensus-based recommendations

- Stroke survivors with identified perceptual difficulties should have a formal perceptual (i.e. neurological and neuropsychological) assessment.
- Stroke survivors with an identified perceptual impairment and their carer should receive:
  - verbal and written information about the impairment;
  - an assessment and adaptation of their environment to reduce potential risk and promote independence;
  - practical advice/strategies to reduce risk (e.g. trips, falls, limb injury) and promote independence;
  - intervention to address the perceptual difficulties, ideally within the context of a clinical trial.

Practical Info

It is recommended that assessment for perceptual difficulties also occurs through the observation of functional performance to determine the functional implications for stroke survivors, and aspects that may promote independence, including environmental, verbal and physical cues.

Attention and concentration

Attention is the process of selectively concentrating on a discrete aspect of information while ignoring other information. Attention has also been referred to as the allocation of limited processing resources. Attention is a fundamental component of most cognitive and perceptual processes and, as such, an impairment of attention may have a significant effect on function. Attention impairments may be specific (e.g. selective, sustained, divided) or more generalised, affecting alertness and speed of processing, as characterised by poor engagement and general slowness. Deficits in attention are among the most commonly observed impairments after stroke (Loetscher and Lincoln 2013).

A Cochrane review (6 RCTs, N = 223) found that cognitive rehabilitation improved measures of divided attention (SMD 0.67, 95% CI 0.35 to 0.98; P < 0.0001) in the short term, but not for global measures of attention or functional outcome; nor did it provide persisting benefits. The review considered attention treatments to be any form of intervention with the aim of improving attention abilities. There was insufficient evidence to support or refute cognitive rehabilitation providing persisting improvements in attention (Loetscher, Potter, Wong et al 2019 *[329]*).

Good practice statement

Consensus-based recommendation

For stroke survivors with attentional impairments or those who appear easily distracted or unable to concentrate, a formal neuropsychological or cognitive assessment should be performed.

Weak recommendation

For stroke survivors with attention and concentration deficits, cognitive rehabilitation may be used. (Loetscher et al. 2019 *[329]*; Rogers et al. 2018 *[330]*; Virk et al. 2016 *[325]*)

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Cognitive rehabilitation provided some benefit for divided attention in the short term, but no persisting benefit. It did not show benefit in the short or long term for any other attentional domains or functional outcomes. A statistically significant effect was found in favour of cognitive rehabilitation when compared with control (Loetscher et al. 2019 *[329]*) (four studies, 165 participants; SMD 0.67, 95% CI 0.35 to 0.98; P value < 0.0001). No significance was found for selective and alternative measures or alertness.

Certainty of the Evidence

Moderate

Overall we have moderate confidence in the effect estimates.

Values and preferences

No substantial variability expected

Client and family preference should be considered when providing cognitive rehabilitation.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

It is unclear whether cognitive rehabilitation (including both restorative and compensatory approaches) improves attention and concentration. The results suggest there may be a short-term effect on attentional abilities, but additional research is required to assess the persisting effects and measure attentional skills in daily life. These trials need higher methodological quality and better reporting.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Cognitive rehabilitation
Comparator: Control

Summary

Three systematic reviews (Loetscher et al 2019 *[329]*; Virk et al 2015 *[325]*; Rogers et al 2018 *[330]*), found that cognitive rehabilitation improved divided attention in stroke survivors. No benefit was shown for sustained, selective or alternating attention or alertness.

The Cochrane review by Loetscher et al (2019) included 6 randomised controlled trials (RCTs), involving 223 participants with impaired attention following stroke. Interventions used in the trials either aimed to restore attentional functions or provide compensatory strategies. Meta-analysis showed no significant differences in global attention either immediately following treatment or in the long term. However, pooled results from 4 trials showed an improvement in divided attention at the end of intervention. The review authors concluded that there was insufficient evidence to confirm the benefits of cognitive rehabilitation.

Rogers et al (2018) included 22 RCTs (n=1098). Meta-analysis of 10 studies with attention outcomes found a small

effects due to cognitive remediation (ES 0.40; 95% CI 0.22-0.59).

The systematic review by Virk et al (2015) included 12 RCTs (n=584) but this included studies with mixed populations including patients with traumatic brain injury and central nervous system-impacting malignancy. 6 trials including only stroke patients were included in a subgroup analysis. Cognitive rehabilitation improved divided attention in stroke survivors (Hedges' g 0.67; 95%CI 0.35 to 0.98). Sustained attention, selective attention and alternating attention were not significantly improved in any ABI population. Follow-up data showed no evidence of long-term benefit.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Cognitive rehabilitation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Sustained attention Immediately after intervention 7 Critical	Measured by: Various e.g. IVA-CPT, TAP, Konzentrations-Verlaufs-Test High better Based on data from 169 participants in 4 studies. [1] (Randomized controlled) Follow up: 3 to 11 weeks of treatment.	Difference:	**SMD 0.39 higher** (CI 95% 0.16 lower — 0.94 higher)	**Moderate** Due to serious risk of bias [2]	Cognitive rehabilitation probably has little or no difference on sustained attention
Divided attention Immediately after intervention 7 Critical	Measured by: Various e.g. PASAT, TAP divided attention, Trail Making B High better Based on data from 165 participants in 4 studies. [3] (Randomized controlled) Follow up: 3 to 11 weeks of treatment.	Difference:	**SMD 0.67 higher** (CI 95% 0.35 higher — 0.98 higher)	**Moderate** Due to serious risk of bias [4]	Cognitive rehabilitation probably improves divided attention
Alertness At follow up 7 Critical	Measured by: Various e.g. assessed with TAP phasic alertness, Wiener Reaktionsgerat Visual RT, Simple RT & Tempo-Lern Test High better Based on data from 31 participants in 1 studies. [5] (Randomized controlled) Follow up: 3 months.	Difference:	**SMD 0.26 lower** (CI 95% 0.97 lower — 0.45 higher)	**Very low** Due to serious risk of bias, Due to very serious imprecision [6]	We are uncertain whether cognitive rehabilitation increases or decreases alertness
Selective attention At follow up 7 Critical	Measured by: Various e.g. Bells test, TAP selective attention, Cognitrone, Stroop High better Based on data from 99 participants in 2 studies. [7] (Randomized controlled) Follow up: 3 to 6 months.	Difference:	**SMD 0.07 higher** (CI 95% 0.32 lower — 0.47 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [8]	Cognitive rehabilitation may have little or no difference on selective attention

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Cognitive rehabilitation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Sustained attention At follow up 7 Critical	Measured by: Various e.g. IVA-CPT, TAP, Konzentrations-Verlaufs-Test High better Based on data from 66 participants in 1 studies. [9] (Randomized controlled) Follow up: 6 months.	Difference:	**SMD 0.05 higher** (CI 95% 0.44 lower — 0.53 higher)	**Very low** Due to serious risk of bias, Due to very serious imprecision [10]	We are uncertain whether cognitive rehabilitation increases or decreases sustained attention
Divided attention At follow up 7 Critical	Measured by: Various e.g. PASAT, TAP divided attention, Trail Making B High better Based on data from 99 participants in 2 studies. [11] (Randomized controlled) Follow up: 3 to 6 months.	Difference:	**SMD 0.36 higher** (CI 95% 0.04 lower — 0.76 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [12]	Cognitive rehabilitation may have little or no difference on divided attention
Alertness Immediately after intervention 6 Important	Measured by: Various e.g. TAP intrinsic alertness, Cognitrone, Simple reaction time High better Based on data from 136 participants in 4 studies. [13] (Randomized controlled) Follow up: 3 to 11 weeks of treatment.	Difference:	**SMD 0.14 higher** (CI 95% 0.2 lower — 0.48 higher)	**Moderate** Due to serious risk of bias [14]	Cognitive rehabilitation probably has little or no difference on alertness
Selective attention Immediately after intervention 7 Critical	Measured by: Various e.g. Bells test, TAP selective attention, Cognitrone, Stroop High better Based on data from 223 participants in 6 studies. [15] (Randomized controlled) Follow up: 3 to 11 weeks of treatment.	Difference:	**SMD 0.08 lower** (CI 95% 0.35 lower — 0.18 higher)	**Moderate** Due to serious risk of bias [16]	Cognitive rehabilitation probably has little or no difference on selective attention

1. Systematic review [329] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Blinding of participants not possible, resulting in potential for performance bias, concealment and sequence generation not well reported. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Low number of patients. **Publication bias: no serious.**
3. Systematic review [329] . **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Blinding of participants not possible, resulting in potential for performance bias, concealment and sequence generation not well reported. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Low number of patients. **Publication bias: no serious.**
5. Systematic review [329] . **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: serious.** Blinding of participants not possible, resulting in potential for performance bias, concealment and sequence generation not well reported. **Inconsistency: no serious. Indirectness: no serious. Imprecision: very serious.** Only data from one study, Wide confidence intervals, Low number of patients. **Publication bias: no serious.**

7. Systematic review [329] . **Baseline/comparator:** Control arm of reference used for intervention.
8. **Risk of Bias: serious.** Blinding of participants not possible, resulting in potential for performance bias, concealment and sequence generation not well reported. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients, Wide confidence intervals. **Publication bias: no serious.**
9. Systematic review [329] . **Baseline/comparator:** Control arm of reference used for intervention.
10. **Risk of Bias: serious.** Blinding of participants not possible, resulting in potential for performance bias, concealment and sequence generation not well reported. **Inconsistency: no serious. Indirectness: no serious. Imprecision: very serious.** Only data from one study, Wide confidence intervals, Low number of patients. **Publication bias: no serious.**
11. Systematic review [329] . **Baseline/comparator:** Control arm of reference used for intervention.
12. **Risk of Bias: serious.** Blinding of participants not possible, resulting in potential for performance bias, concealment and sequence generation not well reported. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients, Wide confidence intervals. **Publication bias: no serious.**
13. Systematic review [329] . **Baseline/comparator:** Control arm of reference used for intervention.
14. **Risk of Bias: serious.** Blinding of participants not possible, resulting in potential for performance bias, concealment and sequence generation not well reported. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Low number of patients. **Publication bias: no serious.**
15. Systematic review [329] . **Baseline/comparator:** Control arm of reference used for intervention.
16. **Risk of Bias: serious.** Blinding of participants not possible, resulting in potential for performance bias, concealment and sequence generation not well reported. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Weak recommendation

For stroke survivors with attention and concentration deficits, exercise training and leisure activities may be provided. (Liu-Ambrose et al. 2015 *[326]*)

Practical Info

The evidence for the benefits of exercise training and leisure activities comes from a single trial of people later after stroke (Liu-Ambrose et al. 2015 *[326]*) which, while not excluding participants on the basis of severity of cognitive impairment, did include a sample of people with predominantly mild cognitive impairment. This means that the effectiveness of these interventions on people with moderate to severe cognitive impairment remains unknown.

Evidence To Decision

Benefits and harms

Substantial net benefits of the recommended alternative

A six-month community-based structured program that included two sessions of exercise training and one session of recreation and leisure activities per week significantly improved selective attention and conflict resolution (p = 0.02) at the end of the six-month intervention period compared with usual care (Liu-Ambrose et al. 2015 *[326]*). Improved selective attention and conflict resolution were significantly associated with functional capacity at six months (r = 0.39, p = 0.04). No adverse events were reported.

Certainty of the Evidence

Low

This was a small single trial (N = 28), so our confidence in the effect estimates is low.

Values and preferences

Substantial variability is expected or uncertain

The target population for exercise training would need to be carefully selected, given the wide variation in mobility and

preferences for physical activity.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

While the study was a proof-of-concept trial and thus numbers were small (n = 28), the results demonstrated significant benefits to the participants both at the impairment level and in functional capacity (Liu-Ambrose et al. 2015 *[326]*). The intervention is not suitable for all stroke survivors as it largely depends on their level of independence and overall general health.

Clinical Question/ PICO

Population: Adults with chronic stroke
Intervention: Exercise training
Comparator: Usual care

Summary

Liu-Ambrose and Eng (2015) *[326]* assessed the effect of a six-month exercise and recreation program on executive functions in adults with chronic stroke in a randomised controlled trial (n = 28). The intervention group received a six-month community-based structured program that included two sessions of exercise training and one session of recreation and leisure activities per week. The control group received usual care. The intervention group significantly improved selective attention and conflict resolution (p=0.02) at the end of the six-month intervention period. Improved selective attention and conflict resolution was significantly associated with functional capacity at six months (r=0.39; p=0.04). The authors concluded "that an exercise and recreation program can significantly benefit executive functions in community-dwelling chronic stroke survivors who are mildly cognitively impaired – a population at high-risk for dementia and functional decline. Thus, clinicians should consider prescribing exercise and recreational activities in the cognitive rehabilitation of chronic stroke survivors". However, due to the small sample size in this single study and the fact that confidence intervals were not reported for the between-group comparisons, there is considerable uncertainty about the degree of benefit that might be seen in patients receiving exercise training.

A RCT by Kongkasuwan et al. (2016) *[337]* with 118 stroke patients who were older than 50 years investigated the effect of creative art therapy plus conventional physical therapy, compared with physical therapy only, in improving cognitive ability. Abreviated mental test was used to assess cognition. No difference was found between groups on this measure. Patients in the experimental group self-reported greater concentration. Intervention made no difference (objectively) to attention.

Park et al. (2018) *[340]* conducted a RCT (n=30) comparing the effect of cognitive-motor dual-task training (CMDT) combined with auditory motor synchronization training (AMST) versus CMDT alone in chronic stroke patients. Changes in cognitive function were evaluated using the trail making test (TMT), digit span test (DST), and stroop test (ST). Performance speed on the TMT-A was faster in the CMDT+AMST group than in the CMDT group. Moreover, DST-forward and DST-backward scores were higher in the CMDT+AMST group than in the CDMT group. The authors concluded that the combined therapy CMDT and AMST can be used to increase attention, memory, and executive function for people with stroke.

Li,X et al (2022) *[535]* reviewed 11 studies (n = 824) on the effects of aerobic exercise on cognitive function. Global cognition ability was significantly improved after aerobic exercise intervention (SMD = 0.51; 95% CI: 0.16 to 0.86), however there were no significant improvements in attention.

Outcome Timeframe	Study results and measurements	Comparator Usual care	Intervention Exercise training	Certainty of the Evidence (Quality of evidence)	Plain language summary
Selective attention and conflict resolution [1] After 6 months of treatment 7 Critical	Measured by: Improvement over 6 months on Stroop test High better Based on data from 24 participants in 1 studies. [2] (Randomized controlled) Follow up: 6 months of treatment.	6.7 seconds (Mean) Difference:	24.6 seconds (Mean) **MD 17.9 higher**	**Low** The difference between groups was significant. Due to very serious imprecision [3]	Exercise training and leisure/recreation activities may improve selective attention and conflict resolution

1. Liu-Ambrose et al. (2015) used the Stroop test for assessing selective attention and conflict resolution, measuring "the time difference between naming the ink colour in which the words were printed (while ignoring the word itself) and naming coloured Xs. Smaller time differences indicate better performance"
2. Primary study[326]. Liu-Ambrose (2015) used a non-parametric test to compare the intervention and control groups due to non-normality of the outcome, so do not report a CI for the difference between groups.. **Baseline/comparator:** Control arm of reference used for intervention.
3. **Inconsistency: no serious.** N/A: Single trial. **Indirectness: no serious. Imprecision: very serious.** Only data from one study, Low number of patients, Precision unclear: confidence intervals not reported. **Publication bias: no serious.** N/A: Single study.

Attached Images

Memory

It is estimated that one-third of stroke survivors will have some form of memory loss. People with stroke with memory deficits can have longer hospital stays, poorer functional outcomes, risks to personal safety, and memory deficits can cause subjective distress to people with stroke and their families. It should be noted that memory loss can be associated with damage to other cognitive functions such as executive function and attention.

While there is some evidence for memory training in other brain injury populations, the evidence is very limited in stroke and not sufficient to make a recommendation. Further research is required.

Weak recommendation

New

For stroke survivors with memory deficits, cognitive rehabilitation may be used to improve memory function in the short term. Memory rehabilitation strategies may include internal (mental) strategies (e.g. association, mental rehearsal, rhymes) and external compensatory aids (e.g. notebooks, diaries, calendars, alarms, audio recordings, photos, mobile phones). (das Nair et al 2016 *[344]*; Withiel et al 2019 *[351]*)

Practical Info

Cognitive rehabilitation interventions that target memory functions (hereafter referred to as memory rehabilitation strategies) include interventions that are designed to support memory encoding, consolidation and retrieval, to enable participation in everyday activities. Psychoeducation is a key component of many memory rehabilitation programs (das Nair et al 2016*[344]*). 'Internal' or mental strategies, such as face-name association, mental rehearsal/retrieval practice, and mnemonics can be cognitively demanding and many rely on intact executive functions, so the severity and nature of cognitive impairment is an important consideration in treatment planning. Consideration should also be given to an individual's broader circumstances and the impact that may be having on their ability to engage in the cognitive rehabilitation interventions. Depending on the

individual, it may be necessary to address broader circumstances initially, including providing any emotional support for individual needs, before implementing memory rehabilitation interventions.

External memory aids involve use of tools and aids external to the person, and vary in format from paper-based or electronic notebooks, diaries, journals, calendars, to smartphone applications that can provide a variety of functions such as alerting reminders. Consideration should be given to individual patient preference for use of memory aids, and the context in which they are intended to be used.

Consideration should be given to optimising delivery of memory rehabilitation interventions through both individual and group programs (das Nair et al 2016*[344]*). Group programs enable connection and sharing of ideas and experiences between participants, whereas individual interventions can be more selectively tailored according to needs and preferences (Lawson et al 2020*[359]*; Withiel et al 2020*[355]*).

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Cognitive rehabilitation appears to improve subjectively reported memory immediately after the intervention (das Nair et al 2016 *[344]*). However, longer term outcomes were non-significantly higher. Effects appear modest. No adverse events were found.

Certainty of the Evidence

Moderate

The certainty of evidence was low to moderate.

Values and preferences

No substantial variability expected

People with stroke have reported valuing and enjoying participation in memory interventions irrespective of approach (Withiel et al 2020 *[355]*). We therefore don't expect variation in willingness to participate in cognitive rehabilitation, however, an individual's broader circumstances should be taken into account when determining their level of engagement in the activities.

Resources and other considerations

Important issues, or potential issues not investigated

Some cognitive rehabilitation approaches involve using a computer, software or applications on smartphones/tablets with associated training requirements considered prior to implementation. Relevant training will need to be provided to ensure resources are available.

There were no economic studies identified for memory training interventions.

Rationale

Low to moderate certainty evidence suggests that memory rehabilitation strategies (i.e. internal and external compensations) can improve subjective reports of everyday memory in the short term (first assessment post intervention, which was a minimum of four weeks). The effectiveness of memory rehabilitation on everyday functioning in the long term (second assessment point after the intervention, which was a minimum of three months) remains inconclusive (das Nair et al 2016 *[344]*). The das Nair et al systematic review did not compare the efficacy of restorative 'drill-and-practice' approaches with compensatory (internal and external) strategy training.

A randomised controlled trial comparing restorative computerised cognitive training with compensatory memory skills training found that the latter group showed significantly greater attainment of memory goals and internal strategy use at 6-week follow-up (Withiel et al 2019 *[351]*), justifying the inclusion of internal and external compensatory strategies as suggested memory rehabilitation techniques in the recommendation. This is also consistent with memory rehabilitation evidence and practice guidelines in the broader acquired brain injury literature (e.g. Velikonja et al 2014*[358]*).

Clinical Question/ PICO

Population: People with stroke with memory problems
Intervention: Memory training as part of cognitive rehabilitation
Comparator: no memory training

Summary

das Nair et al (2016)*[344]* included 13 trials involving 514 participants. There was a significant effect of treatment on subjective reports of memory in the short term (SMD 0.36, 95% CI 0.08 to 0.64, P = 0.01, moderate quality of evidence), but not the long term (SMD 0.31, 95% CI -0.02 to 0.64, P = 0.06, low quality of evidence). The SMD for the subjective reports of memory had small to moderate effect sizes. The results do not show any significant effect of memory rehabilitation on performance in objective memory tests, mood, functional abilities, or quality of life.

De Luca et al (2018)*[348]* (n=35) compared computerized cognitive rehabilitation plus standard cognitive rehabilitation compared to standard cognitive rehabilitation alone. No difference was found on measures of memory (Rey Auditory Verbal Learning Test).

Withiel et al (2019) *[351]* (n=65) compared a compensatory memory skills group intervention with a restorative computerized training and waitlist control. Personal memory goals were achieved more in the memory training group compared to computerised training or control group at the end of intervention and at 6 week follow-up. There was no significant differences between groups regarding secondary measures including neuropsychological measures of memory or subjective memory questionaires.

Outcome Timeframe	**Study results and measurements**	**Comparator** no memory training	**Intervention** Memory training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Subjective memory measures (immediate outcome) - Memory questionnaires [1] 7 Critical	Measured by: Various memory questionnaires Based on data from 215 participants in 7 studies. [2] (Randomized controlled) Follow up: 4 weeks to 5 months.	Difference:	**SMD 0.36 higher** (CI 95% 0.08 higher — 0.64 higher)	**Moderate** Downgraded one level due to serious study limitations (four of the seven included studies had two areas with high risk of bias, alongside several unclear judgements	Cognitive rehabilitation appears to improve short term memory via subjective measures
Subjective memory measures (long-term outcome) - Memory questionnaires [3] 7 Critical	Measured by: Subjective memory measures Based on data from 149 participants in 3 studies. [4] (Randomized controlled) Follow up: 3 months to 7 months.	Difference:	**SMD 0.31 higher** (CI 95% 0.02 lower — 0.64 higher)	**Low** Downgraded due to serious study limitations and indirectness	Cognitive rehabilitation may improve subjective memory
Objective memory measures (immediate outcome) - Comprehensive batteries [5]	Measured by: RBMT, WMS Based on data from 91 participants in 5 studies. [6] Follow up: 6 weeks to 5 months.	Difference:	**SMD 0.25 higher** (CI 95% 0.36 lower — 0.86 higher)	**Very low** Downgraded three levels in total. Downgraded one level due to inconsistency (I2 statistic of 42%), one level due to	We are uncertain if cognitive rehabilitation improves memory based on RBMT or WMS

Outcome Timeframe	**Study results and measurements**	**Comparator** no memory training	**Intervention** Memory training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
7 Critical				indirectness (four of the five included studies used mixed diagnoses samples), and one due to imprecision (wide confidence intervals for this outcome).	
Objective memory measures (immediate outcome) - Verbal memory sub-tests [7] 7 Critical	Measured by: Verbal memory sub-tests (various) Based on data from 266 participants in 5 studies. [8] Follow up: 4 - 12 weeks.	Difference:	**SMD 0.21 higher** (CI 95% 0.03 lower — 0.46 higher)	**Moderate** Downgraded one level due to serious study limitations (four of the five included studies had two areas with high risk of bias, alongside several unclear judgements).	Cognitive rehabilitation appears to improve verbal memory
RBMT (long-term outcome) 7 Critical	Measured by: Rivermead Behavioural Memory Test Based on data from 49 participants in 3 studies. [9] (Randomized controlled) Follow up: 18 weeks to 7 months.	Difference:	**SMD 0.17 lower** (CI 95% 0.74 lower — 0.41 higher)	**Low** Downgraded two levels due to indirectness (two of the three studies used mixed diagnoses samples, and all three had very small sample sizes).	Memory training may have little or no difference on RBMT (long-term outcome)
Functional ability measures (immediate outcome) - Functional ability measures [10] 8 Critical	Measured by: Various functional measures Based on data from 164 participants in 3 studies. [11] (Randomized controlled) Follow up: 4 weeks to 5 months.	Difference:	**SMD 1.17 higher** (CI 95% 0.35 lower — 2.68 higher)	**Very low** Downgraded four levels in total. Downgraded one level due to serious study limitations (there were a number of unclear judgements, specifically in Chen 2006), one level due to inconsistency (I2 statistic of 93%), one level due to indirectness, and one level due to imprecision.	It is unclear if cognitive rehabilitation improves measures of functional ability

1. Assessed with: Metamemory in Adulthood Questionnaire, EMQ, Memory Questionnaire, Memory Assessments Clinics rating scale, Memory Functioning Questionnaire (frequency of forgetting - carer), CAPM-M self, CFQ Follow-up: range 4 weeks to 5 months

2. Systematic review [344] with included studies: Westerberg 2007, Kaschel 2002, Aben 2014, Lannin 2014, Doornhein 1998, das Nair 2012, Radford 2012. **Baseline/comparator:** Control arm of reference used for intervention.
3. Assessed with: Metamemory in Adulthood Questionnaire, EMQ, Memory Assessments Clinics rating scale
4. Systematic review [344] with included studies: Aben 2014, das Nair 2012, Kaschel 2002. **Baseline/comparator:** Control arm of reference used for intervention.
5. RBMT, WMS
6. Systematic review [344] with included studies: Lannin 2014, Lin 2014, Kaschel 2002, Åkerlund 2013, das Nair 2012. **Baseline/comparator:** Control arm of reference used for intervention.
7. RBMT story recall, 15 words test, RAVLT delayed, Claeson-Dahl delayed
8. Systematic review [344] with included studies: Doornhein 1998, Westerberg 2007, Zucchella 2014, Radford 2012, Aben 2014. **Baseline/comparator:** Control arm of reference used for intervention.
9. Systematic review [344] with included studies: Åkerlund 2013, das Nair 2012, Kaschel 2002. **Baseline/comparator:** Control arm of reference used for intervention.
10. FIM, EADL, unspecified functional independence measure
11. Systematic review [344] with included studies: Chen 2006, das Nair 2012, Zucchella 2014. **Baseline/comparator:** Control arm of reference used for intervention.

Attached Images

Consensus recommendation

Updated

Any stroke survivor found to have memory impairment causing difficulties in rehabilitation or adaptive functioning should:

- be referred to a suitably qualified healthcare professional for a more comprehensive neuropsychological and functional assessment of their memory abilities and needs;
- have their nursing and therapy sessions tailored to use techniques that capitalise on preserved memory abilities and existing memory strategies (both internal and external);
- be comprehensively trained on how to use internal strategies (e.g. assocation, mental rehersal, mnemonics) and external strategies (e.g. notebooks, diaries, audio recordings, smartphone memory apps and alarms);
- have therapy delivered in an environment as similar to the stroke survivor's usual environment as possible to encourage generalisation.

Clinical Question/ PICO

Population: Adults with memory impairment following a stroke
Intervention: Brain stimulation
Comparator: Control

Summary

Yan et al. (2020) *[331]*systematically reviewed studies that assessed the effect of transcranial direct-current stimulation (tDCS) on cognitive function in stroke patients.Three RCTs with 150 patients that reported memory outcomes were identified. The review identified no significant memory outcomes between patients who received anodal tDCS and passive tDCS (SMD 0.41; 95% CI -0.67-1.50).

Tsai et al. (2020) *[336]* investigated the effect of repetitive transcranial magnetic stimulation (rTMS) in treating cognitive impairment in patients with left hemispheric stroke. Forty one patients were allocated to receive one of three groups; 5 Hz rTMS or intermittent theta burst stimulation (iTBS) or sham stimulation for 10 sessions over 10 days. The 5 Hz rTMS group showed significantly greater improvement than the sham group in Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) total score ($p = 0.006$) and delayed memory ($p < 0.001$). The iTBS group showed significantly greater improvement than the sham group in RBANS total score ($p = 0.005$) and delayed memory ($p = 0.007$) immediately post intervention. No long term follow up was reported.

Li et al (2022) *[534]* reviewed 10 studies (n - 347) on the effectiveness of repetitive transcranial magnetic stimulation (rTMS) in cognition impairment. Subgroup analysis found that memory significantly improved in rTMS compared to sham treatment (MD = 1.68; 95% CI: 0.36 to 2.99, 3 studies, n = 99) as measured by Rivermead Behavioral Memory Test (RBMT).

Hara et al (2021) *[540]* reviewed 10 studies (n = 417) on the effectiveness and safety of various non-invasive brain stimulation interventions. Working memory was significantly improved in repetitive transcranial magnetic stimulation (rTMS) compared to sham (SMD = 1.35, 95% CI: 0.95 to 1.76, 3 studies, n = 118) but showed no significant effect in transcranial direct current stimulation (tDCS) compared to sham.

Goa et al (2023) *[541]* reviewed 8 studies (n = 336) on the effectiveness of repetitive transcranial magnetic stimulation (rTMS) combined with cognitive training. Large effects were found for rTMS + cognitive training on global cognition (g = 0.780, 95 % CI = 0.477–1.083) and working memory (g = 0.609, 95 % CI = 0.158–1.061). Subgroup analyses showed that combinations of phase of stroke onset, rTMS frequency, stimulation site and stimulation sessions were potent factors that modulate the effects of rTMS + cognitive training for cognitive function outcomes.

Xu et al (2022) *[543]* reviewed 10 studies (n = 591) on the treatment effect of repetitive transcranial magnetic stimulation (rTMS) on attention and memory. rTMS significantly improved memory as measured by Rivermean Behavioural Memory Test (RMBT); MD = 2.06, 95% CI: 1.17 to 2.95 (7 studies, n = 416) compared to sham control.

There is currently insufficient evidence to form a recommendation and further studies are needed.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Brain stimulation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Memory Post-intervention	Measured by: Minimum Mental State Examination (MMSE) or the Montreal Cognitive Assessment (MoCA) High better Based on data from 150 participants in 3 studies. [1] (Randomized controlled) Follow up: 3-6 weeks.	Difference:	**SMD 0.41 higher** (CI 95% 0.67 lower — 1.5 higher)	**Low** Due to serious inconsistency, Due to serious risk of bias [2]	Brain stimulation may have little or no difference on memory
Memory Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) immediately after intervention	Based on data from 41 participants in 1 studies. [3] (Randomized controlled) Follow up: post-intervention.	The 5 Hz rTMS group showed significantly greater improvement than the sham group in RBANS total score (p = 0.006), and delayed memory (p < 0.001). The iTBS group showed significantly greater improvement than the sham group in RBANS total score (p = 0.005) and delayed memory (p = 0.007).		**Very low** Due to serious imprecision [4]	We are uncertain whether brain stimulation improves or worsen memory

1. Systematic review [331] . **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Incomplete data . **Inconsistency: serious.** The magnitude of statistical heterogeneity was high, with I^2: 89%.
3. Primary study **Supporting references:** [336],
4. **Imprecision: very serious.** Low number of patients, Only data from one study.

Attached Images

Clinical Question/ PICO

Population: Adults with memory impairment following a stroke
Intervention: Exercise
Comparator: Control

Summary

A systematic review by Zheng et al. (2016) *[346]* included 10 studies (6 RCTs, 2 controlled trials, 2 before-after studies; n=392 total participants) assessed the effects of aerobic exercise on cognitive function following stroke. For the domain of memory, four studies (one RCT, one CCT and two before and after studies; n=72 in total) were included with all studies reporting an increase in memory scores although only one outcome with one study was found to be statstically significant. The small randomised trial (Immink et al 2014 *[347]*) reported significant improvement in memory-related quality of life scores after yoga intervention compared to no treatment (p = 0.022).

Tang et al. (2016)*[349]* included 47 stroke participants and assessed the effects of six-month long, three 60-min sessions per week, high-intensity aerobic exercise versus low-intensity non-aerobic balance/ flexibility exercise on cognitive function. Memory was measured with the Verbal Digit Span Test. There was an improvement in verbal memory in both groups (time effect p = 0.04) but not in any of the other measures of cognition (working memory, set shifting, conflict resolution).

A RCT conducted in China by Zheng et al. (2020) *[352]* investigated the effectiveness and safety of Baduanjin training on the cognitive function of stroke survivors (n=48). Baduanjin exercise consists of eight separate and smooth movements (similar to Tai Chi) and involves meditiative mind, and breathing techniques. Mean differences between groups at 24-week treatment were statistically significant for memory (immediate recall, short-term delayed recognition and long-term delayed recognition). However, no post-treatment follow-up was reported and retention of benefits is unclear.

Li,X et al (2022) *[535]* reviewed 11 studies (n = 824) on the effects of aerobic exercise on cognitive function. Global cognition ability was significantly improved after aerobic exercise intervention (SMD = 0.51; 95% CI: 0.16 to 0.86), however there were no significant improvements in working memory.

There is currently insufficient evidence to form a recommendation and further studies are needed.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Exercise	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Memory - Post-intervention 7 Critical	Measured by: Stroke Impact Scale Domain (SISD) memory domain (score) Scale: 0 — 100 High better Based on data from 31 participants in 2 studies. [1] (Randomized controlled) Follow up: Assessed at post-intervention.	Difference:	**MD 10.38 higher** (CI 95% 0.35 lower — 21.11 higher)	**Low** Due to serious risk of bias, Due to very serious imprecision [2]	We are uncertain whether exercise improves or worsen memory
Memory [3] Post-intervention 7 Critical	Measured by: ACER -memory High better Based on data from 30 participants in 1 studies.	Difference:	**MD 2.2 higher** (CI 95% 0.13 higher — 1.14 higher)	**Very low** Due to very serious imprecision [5]	We are uncertain whether exercise improves or worsen memory (ACER-memory outcome measure)

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Exercise	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Memory [6] Post-intervention 7 Critical	[4] (Randomized controlled) Follow up: 4 weeks post-treatment. Measured by: Auditory Verbal Learning Test (AVLT) -short delay High better Based on data from 20 participants in 2 studies. [7] (Randomized controlled) Follow up: post-treatment.	Difference:	**MD 0.5 higher** (CI 95% 0.13 lower — 1.14 higher)	**Very low** Due to very serious imprecision [8]	We are uncertain whether exercise improves or worsen memory - short-term delayed recognition

1. Systematic review [346] with included studies: [347]. Memory-related quality of life scores signifi cantly improved after yoga intervention (P = .022). **Baseline/comparator:** Primary study. **Supporting references:** [347],
2. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Imprecision: very serious.** Low number of patients.
3. Adenbrooke's Cognitive Examination Revised -memory domain
4. Systematic review [346] . **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [352],
5. **Imprecision: very serious.** Only data from one study, Low number of patients.
6. Auditory Verbal Learning Test
7. Systematic review [346] . **Baseline/comparator:** Control arm of reference used for intervention.
8. **Imprecision: very serious.** Only data from one study, Low number of patients.

Attached Images

Clinical Question/ PICO

Population: Adults with memory impairment following a stroke
Intervention: Music therapy
Comparator: Control

Summary

A Cochrane review by Magee et al. (2017) *[335]* assessed the effects of music interventions for functional outcomes in people with acquired brain injury. Two studies that investigated the effect of music therapy on memory were identified with no significant difference found.

Another systematic review, by Moumdjian et al. (2017)*[333]* assessed the effectiveness of music-based interventions on motricity or cognitive functioning in neurological populations. Three studies (n=139 participants) that exclusively included stroke patients and contained some memory outcomes were identified, and only one was an RCT (n=65). Results were not pooled with conflicting results.

One further trial by Sihvonen et al (2020)*[356]* (n=45) was pooled with a previous study (n=38) (Sarkamo et al 2014). Listening daily to vocal music improved neurophsychological test of verbal memory more than listening to instrumental music or audiobooks. However, all groups achieved similar results at 3 and 6 month timeframes and there was some differences at baseline which may have influenced outcomes.

There is currently insufficient evidence to form a recommendation and further studies are needed.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Music therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Memory [1] 7 Critical	Measured by: Memory -various Based on data from 42 participants in 2 studies. [2] (Randomized controlled)	Difference:	**SMD 0.33 higher** (CI 95% 0.29 lower — 0.95 higher)	**Very low** Due to serious risk of bias, Due to serious imprecision [3]	We are uncertain whether music therapy improves or worsen memory

1. One study assessed short-term working memory using the digit span subtest from the Wechsler Memory Scale-Revised and the other the Rivermead Behavioural Memory Test.
2. Systematic review [354] with included studies: Pool 2012, Särkämö 2008. **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with memory impairment following a stroke
Intervention: Yoga
Comparator: Control

Summary

A systematic review by Silveira and Smart (2019)*[345]* investigated the benefits of yoga on cognitive, physical, and psychological outcomes for patients with acquired brain injury. Six studies were identified in which four included stroke patients. However, only one small (n=25 recruited, n=22 analysed) RCT *[347]* reported memory outcomes in the form of one memory item on the stroke impact scale (SIS). A significant Group x Time interaction on memory domain (p=0.048) was reported in the yoga group compared to no intervention group. There is currently insufficient evidence to form a recommendation and further studies are needed.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Yoga	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Memory Post-intervention	Measured by: Stroke Impact Scale Domain (SISD) memory domain (score) Scale: 0 — 100 High better Based on data from 22 participants in 1 studies. [1] (Randomized controlled) Follow up: Assessed at post-intervention.	Difference:	**MD 15.3 higher** (CI 95% 1.29 higher — 29.3 higher)	**Very low** Due to serious risk of bias, Due to very serious imprecision [2]	We are uncertain whether yoga improves or worsen memory

1. Systematic review [345] . **Baseline/comparator:** Control arm of reference used for intervention. **Supporting references:** [347],
2. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Imprecision: very serious.** Only data from one study, Low number of patients.

Attached Images

Executive function

Executive function is defined as the controlling mechanisms of the brain that include the processes of planning, initiation, organisation, inhibition, problem-solving, monitoring and error correction. Interventions for impaired executive function include strategy and cognitive training. National Stroke Audit results show that 90% of stroke patients are assessed by an occupational therapist and 57% within one day (Stroke Foundation 2019 *[7]*). They also showed that 83% of hospitals have locally agreed assessment protocols for executive function (Stroke Foundation 2019 *[7]*).

There is very little evidence for executive functioning and further research is required.

Info Box

Practice points

- Stroke survivors considered to have problems associated with executive functioning deficits should be formally assessed by a suitably qualified and trained person, using reliable and valid tools that include measures of behavioural symptoms.
- For stroke survivors with impaired executive functioning, the way in which information is provided should be tailored to accommodate/compensate for the particular area of dysfunction.

Weak recommendation

For stroke survivors with cognitive impairment, meta-cognitive strategy and/or cognitive training may be provided. (Zucchella et al. 2014 *[360]*; Skidmore et al. 2015 *[364]*)

Practical Info

Meta-cognitive strategy training (hereafter referred to as strategy training) is an intervention designed to harness a person's ability to monitor, regulate, and positively adapt one's own behavior. Strategy training teaches individuals to identify and

prioritise problematic daily activities, identify problems impeding performance, generate and evaluate strategies addressing these problems, and generalise learning through practice. Thus, strategy training teaches skills that can be used to address disability in “real-life” activities.

The hallmark of strategy training is its delineation between the therapist’s role and the participant’s role in the rehabilitation process. Therapists assume a role of guided discovery, systematically facilitating participants’ learning through prompts and questions rather than directly instructing participants. In doing so, therapists guide participants, allowing participants to learn through their experiences. Explaining to patients about the way the brain functions, may also help their understanding of their own situation.

Through strategy training, participants learn to work through or work around specific problems in selected daily activities. In addition, participants learn how to apply the process to novel activities and situations, with the goal of promoting additional recovery of independence with daily activities long after rehabilitation is completed (Skidmore et al. 2015 *[364]*).

It is important that the person's grief surrounding their changed situation is also addressed.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Meta-cognitive strategy training and cognitive training may have some small benefits on measures of executive function, although evidence is not strong (Zucchella et al, 2014 *[360]*; Skidmore et al, 2015 *[364]*). No harms are anticipated from this intervention.

Certainty of the Evidence

Low

Low quality due to serious risk of bias, imprecision and inconsistency.

Values and preferences

No substantial variability expected

Client and family preference should be considered when providing meta-cognitive strategy and/or cognitive training.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Implementation considerations

There is an organisational indicator collected in the National Stroke Audit to determine whether hospitals have locally agreed assessment protocols for executive function.

Rationale

Low-level evidence suggests meta-cognitive strategy training may improve executive function, and cognitive training may improve executive function slightly (Zucchella et al. 2014 *[360]*; Skidmore et al. 2015 *[364]*).

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Cognitive training
Comparator: Control

Summary

A Cochrane review by Chung et al (2013) *[362]* investigated cognitive rehabilitation interventions for executive

dysfunction, including 19 randomised trials. The review was not stroke-specific, but included data from 304 stroke patients. No trials were found reporting the review's primary outcome of global executive function. One trial showed significant improvement in concept formation, but other analyses of components of executive function or working memory showed non-significant differences. The review authors concluded that there was insufficient high-quality evidence to determine the benefits of cognitive rehabilitation on cognitive function.

Poulin et al (2012) *[361]* carried out a systematic review of cognitive interventions aimed at remediating executive function impairments or improving functional tasks compromised by executive function impairments. 10 stroke studies of mixed study types were included (2 randomised controlled trials; 1 randomised crossover trial, 4 single-subject design studies, 2 pre-post design studies and 1 pre-post controlled group study). Meta-analysis was not conducted due to the heterogeneity among the studies. Findings were qualitatively synthesised according to stage and intervention approaches, with the 2 randomised controlled trials and 1 randomised crossover trial all classified as 'chronic' stage. The review authors concluded that people with stroke might benefit from specific executive function training and compensatory strategies, but the included studies provide limited evidence regarding these benefits.

Zucchella et al (2014) *[360]* conducted a randomised trial of cognitive rehabilitation involving 92 stroke patients with cognitive deficits. Patients randomised to the intervention group completed 16 x 1 hour sessions over four weeks of therapist-guided computer exercises whereas control group had a sham intervention matched for amount of contact. Neuropsychological domains were assessed with various tools with only significant differences found for domains of memory and visual attention.

Poulin et al (2017) *[370]* reported the feasiblity and effects of an adapted version of the Cognitive Orientation to daily Occupational Performance (CO-OP) approach versus Computer-based EF training (COMPUTER training). Participants received 16 hours of either CO-OP or COMPUTER training and outcomes were assessed post-intervention and at one-month follow-up. Both groups improved but this very small study (n=11) needs to be reproduced before any firm conclusions can be made.

Van de Ven et al (2017) *[372]* in a RCT investigated whether computer-based cognitive flexibility training can improve subjective cognitive functioning and quality of life in 97 stroke patients. The patients were randomly assigned to three groups; intervention group, active control (i.e., mock training), or a waiting list control. All groups improved on the subjective executive functioning and the improvements remained stable 4 weeks after training completion but there was no between group differences.

Park and Lee (2019) *[371]* in a RCT investigated the effectiveness of dual-task training using various cognitive tasks (intervention) versus conventional occupational therapy (control) in 30 stroke patients. Outcomes were assessed for attention, executive function, and motor function. Interventions were conducted for 6 weeks. The intervention group showed a significantly stronger effect than the control group in ST-Color (p = 0.023) assessment.

Faria et al (2020) *[369]* conducted a RCT with 36 stroke patients comparing Reh@City v2.0 (adaptive cognitive training through everyday tasks VR simulations) with Task Generator (TG: content equivalent and adaptive paper-and-pencil training). Outcome measures included general cognitive functioning (assessed by the Montreal Cognitive Assessment - MoCA), Trail Making Test A and B (TMT), Digit Span (WMS-III) & Symbol search, but did not use activity measures. The Reh@City v2.0 group improved significantly more than the TG group in terms of general cognitive functioning, memory retention and recognition. The Reh@City v2.0 group also showed improvements in the Digit Symbol Coding codification task post-intervention. While promising, these results are further studies are needed to confirm the findings.

O'Donoghue et al (2022) *[542]* reviewed 64 studies (n = 4,005) on the effectiveness of rehabilitation interventions across multiple domains of cognitive function. Multiple component interventions improved cognitive functioning (MD = 1.56; 95% CI: 0.69 to 2.43, 3 studies, n = 429) compared with standard care.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Cognitive training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Executive functioning (FAB) Post intervention - 4 weeks of treatment	Measured by: Frontal Assessment Battery (FAB) High better Based on data from 87 participants in 1 studies.	**13.8** points (Median) Difference:	**13.9** points (Median) **0.1 higher**	**Low** Due to serious risk of bias, Due to serious imprecision. The difference between groups	Cognitive training may have little or no difference on executive functioning (FAB)

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Cognitive training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
	[1] (Randomized controlled) Follow up: 4 weeks after baseline.			was non-significant. No confidence interval was reported for the difference. [2]	
Executive functioning (TMT-B) Post intervention - 4 weeks of treatment	Measured by: Trail Making Test B Lower better Based on data from 87 participants in 1 studies. [3] (Randomized controlled) Follow up: 4 weeks after baseline.	318 (Median) Difference:	259 (Median) **59 lower**	**Low** Due to serious risk of bias, Due to serious imprecision. The difference between groups was significant (p = 0.03) but no confidence interval was reported. [4]	Cognitive training may increase executive functioning (TMT-B) slightly

1. Primary study[360]. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Does not report using intention-to-treat analysis. . **Inconsistency: no serious. Indirectness: no serious.** The outcome time frame in studies was insufficient. **Imprecision: serious.** Low number of patients, Only data from one study. **Publication bias: no serious.**
3. Primary study[360]. **Baseline/comparator:** Primary study.
4. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias. **Inconsistency: no serious.** Point estimates vary widely. **Indirectness: no serious. Imprecision: serious.** Only data from one study, Low number of patients. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Strategy training
Comparator: Attention control

Summary

A randomised trial including 30 acute stroke patients was conducted by Skidmore et al (2015) *[364]*. Participants in the intervention group received strategy training focussed on developing strategies to achieve self-selected goals, in addition to usual care. The control group received usual care plus reflective listening as an attentional control. Comparisons of Color Word Interference Cognitive Flexibility scores showed significantly improved performance in the strategy training group at 3 and 6 month follow-up. No confidence intervals were reported for the difference, making the range of possible benefits or harms difficult to determine. The trial also included few patients, suggesting serious imprecision in estimating the treatment effects.

Outcome Timeframe	**Study results and measurements**	**Comparator** Attention control	**Intervention** Strategy training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Executive functioning (CWI - Condition 4) At 3 months 7 Critical	Measured by: Improvement from baseline on Color Word Interference - Cognitive Flexibility (Condition 4) High better Based on data from 20 participants in 1 studies. [1] (Randomized controlled) Follow up: 3 months after baseline.	0.72 seconds (Mean) Difference:	5.5 seconds (Mean) **SMD 1.38 higher** n/a	**Low** The between-group difference was significant (p = 0.001). Due to serious risk of bias, Due to serious imprecision [2]	Strategy training may increase executive functioning at 3 months.
Executive functioning (CWI- Condition 4) At 6 months 7 Critical	Measured by: Improvement from baseline on Colour Word Interference - Cognitive Flexibility (Condition 4) High better Based on data from 18 participants in 1 studies. [3] (Randomized controlled) Follow up: 6 months after baseline.	0.52 seconds (Mean) Difference:	4.91 seconds (Mean) **SMD 1.23 higher** n/a	**Low** The difference between groups was significant (p = 0.004). Due to serious imprecision, Due to serious risk of bias [4]	Strategy training may increase executive functioning at 6 months.

1. Primary study[364]. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants, resulting in potential for performance bias. **Inconsistency: no serious.** Point estimates vary widely. **Imprecision: serious.** Only data from one study, Low number of patients.
3. Systematic reviewwith included studies: [364]. **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants, resulting in potential for performance bias. **Inconsistency: no serious.** Point estimates vary widely. **Imprecision: serious.** Low number of patients, Only data from one study.

Attached Images

Limb apraxia

Apraxia is impaired planning and sequencing of movement that is not due to weakness, incoordination, or sensory loss. It is associated with left hemisphere stroke and has a marked impact on the functional performance of activities (Lindsten-McQueen et al. 2014 *[373]*). Estimates of the prevalence of apraxia in people with left hemisphere stroke range from 28% to 51% (Lindsten-McQueen et al. 2014 *[373]*). There are few studies of interventions for apraxia, such as strategy training in ADL (e.g. verbalisation of actions), sensory stimulation (touching the limbs), proprioceptive stimulation (e.g. applying weight to the limbs), cueing, chaining (i.e. breaking tasks into individual steps), and normal movement approaches (in which a clinician guides the body through normal patterns of movement). Speech apraxia is discussed separately (see Apraxia of speech).

Info Box

Practice point
Stroke survivors who have suspected difficulties executing tasks but who have adequate limb movement and sensation should be screened for apraxia.

Practical Info

If a patient is being screened for apraxia, explain why they're being screened, what apraxia is, any implications for the patient, and what the next steps will be.

Weak recommendation

For stroke survivors with limb apraxia, interventions such as gesture training, strategy training and/or errorless learning may be provided. (Lindsten-McQueen et al. 2014 *[373]*)

Practical Info

There is insufficient evidence to recommend a specific approach or the amount of time that should be dedicated to therapy specifically to address limb apraxia. In the absence of evidence, therapists may incorporate the training approaches into therapy sessions.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

There is uncertainty about the benefits of the different treatment strategies for limb apraxia, although there is suggestion of some positive effects (Lindsten-McQueen et al. 2014 *[373]*). People participating in the therapy are at low risk of harm.

Certainty of the Evidence

Low

Included studies have high risk of bias and small sample sizes.

Values and preferences

No substantial variability expected

Stroke survivors may have difficulty understanding the concept of apraxia or recognising the presence of apraxia, but most clients are motivated to improve their limb function. Therefore, it is expected they would want to participate in this treatment approach.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations
No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

Limb apraxia can impact significantly on one's ability to use their limb in functional tasks. There are very few research studies evaluating interventions for limb apraxia and these studies have tested different approaches. At present, the overall quality of evidence is low and the studies have mixed results, suggesting either no benefit or small benefits. Furthermore, there is insufficient evidence to recommend one strategy over another. It is suggested that these strategies are incorporated into therapy sessions.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Strategy training
Comparator: Control

Summary

A systematic review of treatments for apraxia (Lindsten-McQueen et al 2014 *[373]*) included one randomised controlled trial (RCT) of strategy training (N = 113) as well as two studies employing a pre-post test design. The review reported that the RCT showed significant (p = 0.03) improvement in activities of daily living (ADL) following strategy training, with an effect size of 0.37. However, confidence intervals were not reported so the precision of the trial is difficult to determine. The same RCT showed non-significant differences between the strategy training and control groups on the Motricity Index, Functional Motricity Index or The Apraxia Test. This review provides insufficient evidence to confirm the benefits of strategy training for treatment of apraxia.

A narrative review of apraxia assessments and treatments by Dovern et al (2012) *[374]* discussed the same RCT included in the Lindsten-McQueen review, noting that while ADL showed significant differences at 8 weeks, at 5 month follow-up there was no difference between intervention and control groups, suggesting the effects of strategy training may not persist. They concluded that gesture training appeared to be the best-supported treatment for apraxia, although evidence was limited.

The existing evidence suggests that strategy training may improve ADL slightly and may have little or no difference on motor function or apraxia.

Alashram et al (2021) *[548]* reviewed 6 studies (n = 302) evaluating various rehabilitation interventions on limb apraxia post stroke. Significant improvements were found in strategy training combined with occupational therapy compared to occupational therapy alone at end intervention in Barthel index, Activities of daily living, motor function and cognitive function, however only motor function and cognitive function showed significant improvements at 5 month follow up (3 studies, n = 255). Significant improvements were found in gesture training compared to standard aphasia therapy in Limb praxic function evaluation and a small improvement in Limp apraxia screening test (3 studies, n = 47).

Ji and Kwon (2022) *[549]* reviewed 5 studies (n = 310) on the effectiveness of limb apraxia interventions. Subgroup analysis showed Gesture and strategy training had statistically significant effects on Activities of daily living (Effect size = 0.416; 95% CI: 0.159 to 0.673; 4 studies, n = 297). No significant effects were found for total apraxia (TA), ideational apraxia (IA), and ideomotor apraxia (IMA).

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Strategy training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
ADL 8 Critical	Based on data from 113 participants in 1 studies. (Randomized controlled) Follow up: post intervention.	The treatment group improved significantly (p=0.03) in ADL functioning when compared to the control group post intervention. At 5 months there was no difference between the groups.		**Low** Due to serious risk of bias, Due to serious imprecision [1]	Strategy training may improve ADL slightly
Motor function 7 Critical	Based on data from 113 participants in 1 studies. (Randomized controlled) Follow up: post intervention.	No significant difference between groups on the Motricity Index or Functional Motricity Index		**Low** Due to serious risk of bias, Due to serious imprecision [2]	Strategy training may have little or no difference on motor function
Apraxia 7 Critical	Based on data from 113 participants in 1 studies. (Randomized controlled) Follow up: post	No significant difference between groups on The Apraxia Test		**Low** Due to serious risk of bias, Due to serious	Strategy training may have little or no difference on apraxia

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Strategy training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
	intervention.			imprecision [3]	

1. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
2. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
3. **Risk of Bias: serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Error-less learning
Comparator: Control

Summary

A systematic review of treatments for apraxia (Lindsten-McQueen et al 2014 *[373]*) included 1 small trial of errorless learning using a pre-post test design. The trial showed a significant decrease in errors on activities of daily living (ADL) tasks that had been trained, but the improvement did not generalise to other tasks. The narrative review by Dovern et al (2012) *[374]* discussed this trial, noting the lack of benefit at 6-month follow-up. It is uncertain whether error-less learning training for limb apraxia improves performance of activities of daily living.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Error-less learning	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
ADL activities 8 Critical	Based on data from 15 participants in 1 studies. (Observational (non-randomized)) Follow up: Post intervention.	One pre-post test study reported that training resulted in a decrease in errors but that training did not generalise		**Very low** Due to serious risk of bias, Due to serious imprecision [1]	We are uncertain whether error-less learning increases performance of ADL activities

1. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Gesture training
Comparator: Control

Summary

A systematic review of treatments for apraxia (Lindsten-McQueen et al 2014 *[373]*) included 2 small randomised controlled trials (RCTs) of gesture training, with 46 total participants. Both trials reported that gesture training produced significant improvements in both ideational and ideomotor tests of apraxia. 1 trial also reported improvements in gesture comprehension and ADL.

A narrative review of apraxia assessments and treatments by Dovern et al (2012) *[374]* discussed the same RCTs included in the Lindsten-McQueen review, noting the apparent benefits but also the very small sample sizes of the two studies. Since gesture training was the only treatment approach included in their review that appeared to show persisting benefits, they concluded that gesture training appeared to be the best-supported treatment for apraxia. However, the evidence is very limited due to the small number of trials and patients.

The evidence reviewed here suggests that gesture training may slightly improve performance on ideational and ideomotor tests of apraxia.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Gesture training	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Ideational test of apraxia 7 Critical	Based on data from 46 participants in 2 studies. (Randomized controlled) Follow up: Post intervention.	Two RCTs reported that gesture training resulted in significantly improved performance in tests of ideational apraxia		**Low** Due to serious risk of bias, Due to serious imprecision [1]	Gesture training may increase ideational test of apraxia slightly
Ideomotor test of apraxia 7 Critical	Based on data from 46 participants in 2 studies. (Randomized controlled) Follow up: post intervention.	Two RCTs found that those receiving intervention had significantly better performance on tests of ideomotor apraxia		**Low** Due to serious risk of bias, Due to serious imprecision [2]	Gesture training may increase ideomotor test of apraxia slightly

1. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**
2. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Neglect

Unilateral spatial neglect, or hemi-inattention, is the failure to attend to sensory or visual stimuli on the affected side, or to make movements towards one side of the environment, typically the left side due to lesions in the right hemisphere. Unilateral spatial neglect has deleterious effects on all aspects of a person's ADL and is a predictor of poor functional outcome. Neglect was identified in approximately 27% of stroke survivors in Australia (Stroke Foundation 2020*[8]*). Management strategies used included visual scanning with sensory stimulation (72%), eye patching (4%), simple cues (87%), mental imagery training (18%) and other therapies (41%) (Stroke Foundation 2020 *[8]*).

Evidence of the effectiveness of rehabilitation interventions to reduce the impact of neglect and improve ADL performance is inconclusive. Further high-quality research is required.

Info Box

Practice point
Any stroke survivor with suspected or actual neglect or impairment of spatial awareness should have a full assessment using validated tools.

Evidence To Decision

Resources and other considerations

Implementation considerations
There is a clinical indicator collected in the National Stroke Audit on the number of patients with an identified neglect on admission to acute care and/or rehabilitation.

Weak recommendation

For stroke survivors with symptoms of unilateral neglect, cognitive rehabilitation (e.g. computerised scanning training, pen and paper tasks, visual scanning training, eye patching, mental practice) may be provided. (Bowen et al. 2013 *[386]*)

Practical Info

Consideration will need to be given to the specific modality of cognitive rehabilitation (studies included computerised scanning training, pen and paper tasks, visual scanning training, eye patching, and mental practice).

Access and cost of computerised scanning software would need to be considered.

Consideration should also be given to "adaptive cueing" which is individualised, consists of internal and external cues, and is based on neglect severity. No adverse outcomes or contraindications were reported in the literature.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Cognitive rehabilitation should be considered to decrease symptoms of unilateral neglect (Bowen et al. 2013 *[386]*). It is not clear if cognitive rehabilitation improves ADL performance of patients with unilateral neglect (Bowen et al. 2013 *[386]*; Liu et al 2019 *[398]*).

Certainty of the Evidence

Low

Methodological limitations and small sample sizes impacted the quality of evidence available.

Values and preferences

No substantial variability expected

Stroke survivors with unilateral neglect would want to receive appropriate treatments, although the optimal approach remains unclear.

Resources and other considerations

Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

Cognitive rehabilitation should be considered to reduce the symptoms of unilateral neglect. The evidence around the effectiveness of cognitive rehabilitation in improving ADL performance is inconclusive, with further high-quality studies required in this area. Outcome measures should reflect the specific areas of ADL that are targeted in interventions.

It is important to consider the impact of generally poor study design in relation to outcome measures relating to ADL (e.g. using Functional Independence Measure or Barthel Index to measure change relating to an intervention that was delivered through computerised scanning training or pen and paper tasks, is a bit of a stretch when the actual functional tasks were not trained in the studies).

Weak recommendation

For stroke survivors with symptoms of unilateral neglect, mirror therapy may be used to improve arm function and ADL performance. (Thieme et al. 2018 *[227]*)

Practical Info

Information regarding the dosage of mirror therapy requires further exploration, as this varied considerably across studies.

Evidence To Decision

Benefits and harms — Small net benefit, or little difference between alternatives

Mirror therapy improves performance in ADLs, but it is unclear if it improves neglect. (Thieme et al. 2018 *[227]*). No adverse outcomes relating to this intervention have been reported in studies.

Certainty of the Evidence — Low

Moderate quality for ADL measures. Low quality for neglect.

Values and preferences — Substantial variability is expected or uncertain

Patients' preferences may vary due to unclear evidence of benefits for neglect.

Resources and other considerations — Important issues, or potential issues not investigated

Resources considerations

No literature to understand or describe the potential economic implications of this recommendation was identified.

Rationale

Overall there is limited high-quality evidence to support the use of mirror therapy to decrease symptoms of unilateral spatial neglect. However, there is some suggestion that mirror therapy may improve activities of daily living (ADL) performance.

Clinical Question/ PICO

Population: Adults with stroke with neglect
Intervention: Mirror therapy
Comparator: Control

Summary

Thieme et al 2018*[227]* included 62 studies (n=1982) but only 5 studies were pooled related to visuospatial neglect. There was no clear effect found (SMD 1.06, 95% CI −0.10 to 2.23; 5 studies, n=175; low certainty evidence). Mirror therapy did improve ADL (SMD 0.48, 95%CI 0.30 to 0.65; 28 studies, n=898; moderate certainty evidence). But it is unclear how many participants had problems with neglect on enrollment to studies.

O'Donoghue et al (2022) *[542]* reviewed 64 studies (n = 4,005) on the effectiveness of rehabilitation interventions across multiple domains of cognitive function. Mirror therapy interventions improved neglect (MD = 13.99; 95% CI: 12.67 to 15.32, 2 studies, n = 108) compared with active controls.

Fong et al (2022) *[553]* studied (n = 21) the effects of mirror visual feedback compared to action observation or sham control, in subacute patients with left spatial neglect after right hemisphere stroke. At follow up, line crossing (MD = 5.21; 95% CI: 0.81 to 9.62, p = 0.022) was significantly improved in the mirror intervention compared to sham control. Significant time effects were noted in both mirror and action observation interventions in most subtests of the Gap Detection test. However, only mirror intervention showed significant effects results of incomplete circles (left-gap) (MD = 2.14; 95% CI: 0.48 to 3.80, p = 0.013) and incomplete triangles (left-gap) (MD = 2.07; 95% CI: −0.52 to 3.62, p = 0.010) when compared to sham control. Mirror intervention showed no significant advantage over action observation in Fugel-Meyer assessment.

Sim and Kwon (2021) *[560]* studied (n = 28) the effectiveness of bimanual mirror therapy compared to unimanual mirror therapy on severe unilateral neglect in stroke patients. Both groups showed significant improvements measured by the Star Cancelation Test (SCT), Line Bisection Test (LBT), Picture Scanning Test (PST), and Korean Catherine Bergego Scale (K-CBS). However, significant between group differences in bimanual compared to unimanual outcomes of SCT (p = 0.02), LBT(p = 0.04), PST (p = 0.02) and K-CBS (p = 0.03) was also observed. Post intervention the bimanual group showed recovery to normal levels, whereas the unimanual group showed improvement toward mild unilateral neglect.

Zhang et al (2021) *[561]* reviewed 5 studies (n = 238) investigating the effect of mirror therapy on neglect and daily living activities. Mirror therapy combined with other therapies was more effective in improving neglect severity compared with sham mirror therapy combined with other therapies or no treatment (SMD = 1.62; 95% CI: 1.03 to 2.21), noting high heterogeneity between studies (I^2 = 73%). Subgroup analysis showed Mirror therapy had significant improvements in lateral movements (SMD = 1.48; 95% CI: 1.00 to 1.97; 2 studies, n = 84) and bilateral movements (SMD = 1.74; 95% CI: 0.69 to 2.79; 3 studies, n = 154) compared to the control.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** Mirror therapy	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Activities of daily living Post intervention: 4 to 6 weeks 7 Critical	Measured by: ADL (FIM, BI) High better Based on data from 622 participants in 19 studies. (Randomized controlled)	Difference:	points (Mean) **SMD 0.48 higher** (CI 95% 0.3 higher — 0.65 higher)	**Moderate** Due to serious risk of bias [1]	Mirror therapy probably improves activities of daily living at the end of intervention phase.
Visuospatial neglect Post intervention: 6 weeks 7 Critical	Measured by: Various measures High better Based on data from 175 participants in 5 studies. [2] (Randomized controlled)	**-2.33** points (Mean) Difference:	**-1.36** points (Mean) **SMD 1.06 higher** (CI 95% 0.1 lower — 2.23 higher)	**Low**	Mirror therapy may decrease visuospatial neglect at the end of intervention

1. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
2. Systematic review [227] . **Baseline/comparator:** Control arm of reference used for intervention.

Attached Images

Good practice statement

Consensus-based recommendations
Stroke survivors with impaired attention to one side should be:

- given a clear explanation of the impairment;
- taught compensatory strategies systematically, such as visual scanning to reduce the impact of neglect on activities such as reading, eating and walking;
- given cues to draw attention to the affected side during therapy and nursing procedures;
- monitored to ensure that they do not eat too little through missing food on one side of the plate.

Evidence To Decision

Resources and other considerations

Implementation considerations
There is a clinical indicator collected in the National Stroke Audit on the types of management implemented for those patients with identified neglect. These types of management include visual scanning training with sensory stimulation, prism adaptation, eye patching, simple cues and mental imagery training.

Weak recommendation against

Updated evidence, no change in recommendation

Non-invasive brain stimulation should not be used in routine clinical practice to decrease unilateral neglect, but may be used within a research framework. (Salazar et al 2018 *[396]*; Kwon et al 2018 *[394]*; Fan et al 2018 *[393]*)

Practical Info

Details around dosages vary considerably across studies. Side effects of mild headache were seen in three studies only for a small proportion of participants; further exploration of potential harm is required.

Further exploration is also required around scope of practice for modality delivery (i.e. consideration of which practitioners/ clinicians are able to complete training in delivery of this intervention in order to translate this into clinical environments).

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

There is some evidence to support the use of non-invasive brain stimulation to decrease symptoms of unilateral neglect.

No significant adverse outcomes were reported, with three studies reporting mild headache only following stimulation sessions.

Certainty of the Evidence

Low

The evidence comes from several randomised controlled trials, however small sample size in most studies warrants further larger studies in this area.

Methodological differences remain a challenge: some studies suggest electrode placement on the affected side, others suggest electrode placement on the unaffected side; dose and stimulation parameters varied across studies.

Values and preferences

Substantial variability is expected or uncertain

Patients' preferences are likely to vary due to unclear evidence of benefits.

Resources and other considerations

Factor not considered

Rationale

Further clinical trials need to be completed with a standardised protocol recommended before this intervention can be introduced into routine clinical practice for stroke survivors with neglect.

Variations in methodology (i.e. parameters and modes of delivery) makes the introduction into clinical practice of non-invasive brain stimulation challenging at this stage.

Further investigation into the side effects/possible harm is required before introducing this intervention into clinical practice.

Clinical Question/ PICO

Population: Adults with stroke with neglect
Intervention: repetitive transcranial magnetic stimulation (rTMS)
Comparator: Control

Summary

Fan et al. (2018) *[393]* evaluated the effect of noninvasive brain stimulation (NIBS) techniques in the recovery of unilateral neglect in poststroke patients. Twelve studies (11 RCTs) were included. Patients who received active repetitive transcranial magnetic stimulation improved unilateral neglect compared to the control group (Effect size -1.76; 95% CI -2.40 to -1.12). Superseded by 2021 Cochrane review [555].

Similarly, Salazar et al. (2018) *[396]* evaluated the effectiveness of NIBS i.e. repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) on hemispatial neglect and performance in activities of daily living (ADL) after stroke. The review included 10 trials with 226 patients and found that NIBS combined with other therapies significantly improved hemispatial neglect (SMD 1.91; 95% CI -2.57 to -1.25). Subgroup analysis of rTMS interventions versus sham controls also reported positive effect on hemispatial neglect (SMD -2.16; 95% CI -3.00 to -1.33). Superseded by 2021 Cochrane review [555].

Longley et al (2021) *[555]* updated a Cochrane review on non-pharmacological interventions for spatial neglect, including 65 studies (n = 1,951). Results found very uncertain evidence for the effects of non-invasive brain stimulation (rTMS, TBS and cTBS) versus any control, based on measures of persisting functional ability in ADL (SMD = 0.35; 95% CI: -0.08 to 0.77, 3 studies, n = 92).

O'Donoghue et al (2022) *[542]* reviewed 64 studies (n = 4,005) on the effectiveness of rehabilitation interventions across multiple domains of cognitive function. Repetitive transcranial magnetic stimulation (rTMS) significantly improved neglect outcomes post intervention (MD = 20.79; 95% CI: 14.53 to 27.04, 3 studies, n = 95) and 3-6 months after intervention (MD = 18.74; 95% CI: 11.50 to 25.99, 3 studies, n = 68) compared with active controls. Superseded by Cochrane 2021 review [555].

Meidian et al (2022) *[557]* reviewed 13 studies (n = 492) on the effectiveness of different approaches in high-frequency repetitive transcranial magnetic stimulation (rTMS) in unilateral spatial neglect outcomes. Top-down high frequency rTMS was more effective in improving functional abilities and ADL immediately after intervention (SMD = −0.82; 95% CI: −1.55 to −0.10; 3 studies, n = 116) compared to bottom-up application (SMD = 0.03; 95% CI: −0.37 to 0.43; 3 studies, n = 137), but no significant long-term effects were found in either group.

Yang et al (2022) *[562]* reviewed 11 studies (n = 257) on the effects of repetitive transcranial magnetic stimulation (rTMS) in post stroke visuospatial neglect. Significant improvements were found in low-frequency rTMS or continuous theta burst stimulation to the left hemisphere on short- and long-term line bisection test (SMD = -1.10; 95% CI: -1.84 to -0.37, SMD = -1.25; 95% CI: -2.11 to -0.39) and cancellation test (SMD = 1.08; 95% CI: 0.45 to 1.71, SMD = 1.45; 95% CI: 0.42 to 2.47). High heterogeneity in subgroup analysis noted.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** repetitive transcranial magnetic stimulation (rTMS)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Spatial awareness (Line bisection test) [1] Group 1: same day; Group 2: 2 weeks 7 Critical	Measured by: Line bisection test Lower better Based on data from 34 participants in 1 studies. [2] (Randomized controlled) Follow up: 1 day or 2 weeks of treatment.	39.26 mm from midline (Mean) Difference:	14.45 mm from midline (Mean) **MD 24.81 lower** CI 95%	Moderate The difference between groups was significant (controlling for baseline). Discrepancy in timing of follow-up measures across groups may have impacted conclusions around maintenance effects. [3]	rTMS may improve spatial awareness as tested by the line bisection test
Spatial awareness (Letter cancellation test) [4] Group 1: same day; Group 2: 2 weeks 7 Critical	Measured by: Letter cancellation Scale: 0 — 20 High better Based on data from 34 participants in 1 studies. (Randomized controlled) Follow up: 1 day or 2 weeks of treatment.	16.63 points (Mean) Difference:	17 points (Mean) **MD 0.37 higher** CI 95%	Moderate The difference between groups was significant (controlling for baseline). Issues with discrepancy in timing of outcome measures across groups may impact findings/ direct comparisons of groups & associated maintenance effects. [5]	rTMS may improve spatial awareness as tested by the letter cancellation test.
Unilateral neglect (Line bisection test) 4 weeks post-intervention 8 Critical	Measured by: Line bisection test High better Based on data from 30 participants in 1 studies. (Randomized controlled)	34.6 (Mean) Difference:	19.33 (Mean) **MD 10.5 lower** CI 95%	Low Due to very serious imprecision [6]	rTMS may improve unilateral neglect as tested by the line bisection test.
Unilateral neglect (Albert test) 4 weeks post-intervention 8 Critical	Measured by: Albert test High better Based on data from 30 participants in 1 studies. (Randomized controlled)	27.33 (Mean) Difference:	35.55 (Mean) **MD 7.1 higher** CI 95%	Low Due to very serious imprecision [7]	rTMS may improve unilateral neglect as tested by the albert test.
Spatial awareness (Ota's task)	Based on data from 34 participants in 1 studies. (Randomized controlled)	Group 2 (2 weeks of rTMS) showed significantly greater correct responses to O on the left side and responses to		Moderate Discrepancy in timing of	rTMS may improve spatial awareness as tested by ota's task

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** repetitive transcranial magnetic stimulation (rTMS)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Group 1: same day; Group 2: 2 weeks 7 Critical	Follow up: 1 day or 2 weeks of treatment.	reverse C on the left side compared to Group 1 (1 day of rTMS). Between group differences were not significant for responses to O on the left, responses to C on the left, correct responses to C on the left, and correct responses to reverse C on the left.		assessments across groups makes conclusions around sustainability of effects challenging. [8]	

1. discrepancy in timing of follow-up assessments across groups
2. Primary study[378]. **Baseline/comparator:** Control arm of reference used for intervention.
3. **Risk of Bias: no serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Only data from one study. **Publication bias: no serious.**
4. discrepancy in timing of follow-up assessments across groups
5. **Risk of Bias: no serious.** Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Only data from one study. **Publication bias: no serious.**
6. **Inconsistency: no serious. Indirectness: no serious. Imprecision: very serious.** Low number of patients, Only data from one study, no power caalculations. **Publication bias: no serious.**
7. **Inconsistency: no serious. Indirectness: no serious. Imprecision: very serious.** Low number of patients, Only data from one study, no power caalculations. **Publication bias: no serious.**
8. **Risk of Bias: no serious.** Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias. **Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious.** Only data from one study. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke with neglect
Intervention: transcranial direct current stimulation (tDCS)
Comparator: Control

Summary

Fan et al. (2018) *[393]* evaluated the effect of noninvasive brain stimulation techniques in the recovery of unilateral neglect in poststroke patients. Twelve studies (11 RCTs) were included. Patients who received active transcranial magnetic stimulation (tDCS) improved unilateral neglect compared to the control group (effect size [ES] -0.51; 95% CI -1.02 to -0.01). However, subgroup analysis found conflicting results.

A meta-analysis by Kwon (2018) *[394]* broadly evaluated interventions of qualitatively, well-designed studies from the past 10 years for treating visuo-spatial neglect, in patients who had suffered a stroke. Eight RCTs with 237 participants were included. The outcomes were categorised broadly into two as mental function and activity and participation. The effect size of mental function was 0.850, [large effect size] and for activity and participation was 0.536, [medium effect size]. It is diffficult to draw conclusions based on the multiple interventions included in this review and it doesn't really draw conclusions about specific interventions (the review also states this as a limitation).

Similarly, Salazar et al. (2018) *[396]* evaluated the effectiveness of non-invasive brain stimulationon hemispatial neglect and performance in activities of daily living (ADL) after stroke. The review included 10 trials with 226 patients and found

that brain stimulation combined with other therapies significantly improved hemispatial neglect (SMD -1.91; 95% CI -2.57 to -1.25). Subgroup analysis of tDCS versus sham tDCS control reported significant difference (SMD -1.07; 95% CI -1.76 to -0.37).

Zhao et al (2023) *[563]* studied (n = 30) the effectiveness of combining cognitive training and transcranial direct current stimulation (tDCS) with either multi-site or single-site tDCS placement, compared with cognitive training and sham tDCS. Both multi-site and single-site tDCS showed significant improvements in conventional Behavioural Inattention test (p ,0.001), Deviation Index (p = 0.001), Line Crossing test (p = 0.005), Star cancellation test (p = 0.001) and Letter cancellation test (p = 0.004) outcomes compared to the control. However, although between group differences in multi-site versus single-site favoured multi-site tDCS, these results were not significant.

Outcome Timeframe	**Study results and measurements**	**Comparator** Control	**Intervention** transcranial direct current stimulation (tDCS)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Neglect (Motor-Free Visual Perception Test) 3 weeks 7 Critical	Measured by: Motor-Free Visual Perception Test (MVPT) High better Based on data from 12 participants in 1 studies. (Randomized controlled)	25.3 (Mean) Difference:	30.83 (Mean) **MD 5.8 higher** n/a	Very low Due to very serious risk of bias, Due to serious imprecision, Due to serious indirectness [1]	We are uncertain whether transcranial direct current stimulation (tdcs) improves or worsen neglect (motor-free visual perception test).
Neglect (Line Bisection Test) 3 weeks 7 Critical	Measured by: Line Bisection Test Based on data from 12 participants in 1 studies. (Randomized controlled)	5.9 (Mean) Difference:	5.37 (Mean) **MD 0.53 lower** n/a	Very low Due to very serious risk of bias, Due to serious indirectness, Due to serious imprecision [2]	We are uncertain whether transcranial direct current stimulation (tdcs) increases or decreases neglect (line bisection test).
Functional independence 3 weeks 8 Critical	Measured by: Modified Barthel Index Based on data from 12 participants in 1 studies. (Randomized controlled)	69.2 (Mean) Difference:	78.3 (Mean) **MD 9.1 higher** n/a	Very low Due to very serious risk of bias, Due to serious indirectness, Due to serious imprecision [3]	We are uncertain whether transcranial direct current stimulation (tdcs) increases or decreases functional independence.

1. **Risk of Bias: very serious.** Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: serious.** Participants selected from among those with unilateral spatial neglect'; suggesting high risk of bias in participant selection.. **Imprecision: serious.** Low number of patients, Only data from one study, Low number of patients, Only data from one study. **Publication bias: no serious.**
2. **Risk of Bias: very serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: serious.**

Participants selected from among those with unilateral spatial neglect'; suggesting high risk of bias in participant selection.. **Imprecision: serious.** Low number of patients, Only data from one study, Low number of patients, Only data from one study. **Publication bias: no serious.**

3. **Risk of Bias: very serious.** Inadequate sequence generation/ generation of comparable groups, resulting in potential for selection bias, Inadequate concealment of allocation during randomization process, resulting in potential for selection bias, Inadequate/lack of blinding of participants and personnel, resulting in potential for performance bias, Inadequate/lack of blinding of outcome assessors, resulting in potential for detection bias. **Inconsistency: no serious. Indirectness: serious.** Participants selected from among those with unilateral spatial neglect'; suggesting high risk of bias in participant selection.. **Imprecision: serious.** Low number of patients, Only data from one study. **Publication bias: no serious.**

Attached Images

Clinical Question/ PICO

Population: Adults with stroke with neglect
Intervention: Continuous theta-burst stimulation (cTBS)
Comparator: Sham

Summary

A systematic review by Cotoi et al (2019) *[392]* evaluated the effectiveness of theta-burst stimulation compared against placebo or active controls for the treatment of stroke-induced unilateral spatial neglect. Nine studies with 148 patients met the inclusion criteria (7 RCTs and 2 CCTs). Eight studies evaluated a continuous stimulation protocol and one evaluated an intermittent stimulation protocol. Overall, both protocols significantly improved neglect severity (p < 0.05). There were inconsistencies in application of the intervention and its duration varied. Due to heterogeneity, it is difficult to make any conclusive statements about the intervention effectiveness. Superseded by Cochrane 2021 review [555]

Fan et al. (2018) *[393]* evaluated the effect of noninvasive brain stimulation techniques in the recovery of unilateral neglect in poststroke patients. Twelve studies (11 RCTs) were included. Patients who received active transcranial direct current stimulation or repetitive transcranial magnetic stimulation, improved unilateral neglect compared to the control group (-0.51; 95% CI -1.02 to -0.01 and ES -1.76; 95% CI -2.40 to -1.12 respectively). The effect from continuous theta burst stimulation was non-significant (-0.77; 95% CI -1.90 to 0.37; p = 0.18). Superseded by Cochrane 2021 review [555]

Houben et al (2021) *[554]* reviewed 9 studies (n = 187) evaluating theta-burst transcranial magnetic stimulation (TBS) in unilateral neglect following right-hemisphere stroke. Eight included studies evaluated the effectiveness of continuous TBS (cTBS); seven of these studies found significant improvements in neglect amelioration using cTBS compared to sham cTBS, low intensity cTBS or concurrent therapy without cTBS. The remaining included study assessed intermittent TBS (iTBS), finding significant improvements in neglect severity compared to low-intensity iTBS. No meta-analysis was performed. No serious side-effects were reported in the six studies which reported on this, with one study reporting two patients experienced a slight headache after TBS.

Longley et al (2021) *[555]* updated a Cochrane review on non-pharmacological interventions for spatial neglect, including 65 studies (n = 1,951). Results found very uncertain evidence for the effects of non-invasive brain stimulation (rTMS, TBS and cTBS) versus any control, based on measures of persisting functional ability in ADL (SMD = 0.35; 95% CI: -0.08 to 0.77, 3 studies, n = 92).

Outcome Timeframe	**Study results and measurements**	**Comparator** Sham	**Intervention** Continuous theta-burst stimulation (cTBS)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Neglect (Line	Measured by: Line	35.79	11.17	Low	Continuous theta-burst

Outcome Timeframe	**Study results and measurements**	**Comparator** Sham	**Intervention** Continuous theta-burst stimulation (cTBS)	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Bisection Test) 4 weeks 8 Critical	bisection test Lower better Based on data from 20 participants in 1 studies. (Randomized controlled) Follow up: 4 weeks.	(Mean) Difference:	(Mean) **MD 24.62 lower** n/a	Due to very serious imprecision [1]	stimulation (ctbs) may improve neglect (line bisection test).
Neglect (Star cancellation test) 4 weeks 7 Critical	Measured by: Star cancellation test Lower better Based on data from 20 participants in 1 studies. (Randomized controlled) Follow up: 4 weeks.	45.29 (Mean) Difference:	6.25 (Mean) **MD 39.95 lower** n/a	**Low** Due to very serious imprecision [2]	Continuous theta-burst stimulation (ctbs) may improve neglect (star cancellation test).

1. **Inconsistency: no serious. Indirectness: no serious. Imprecision: very serious.** Low number of patients, Only data from one study, no power calculation. **Publication bias: no serious.**
2. **Inconsistency: no serious. Indirectness: no serious. Imprecision: very serious.** Low number of patients, Only data from one study, no power calculations reported. **Publication bias: no serious.**

Attached Images

Telehealth in rehabilitation

Evidence is currently being reviewed for this topic.

Weak recommendation

New

Telehealth services may be used as an alternative approach to delivering rehabilitation, especially for patients who cannot access specialist rehabilitation in the community. It may also be used as an adjunct to in-person therapy. Delivering of specific interventions via telehealth should only be considered for those that have demonstrated benefits. (Laver et al 2020*[64]*)

Practical Info

There are many practical guides and resources on telehealth collated during the COVID-19 pandemic. These can be found at informme.org.au/News/2020/03/26/COVID-19-Telehealth-resources.

In the Cochrane review several different types of technologies are used to deliver telehealth rehabilitation interventions including telephone (8 studies), videoconferencing (10 studies), and desktop videophones (1 study). Other technologies were also used such as video recordings, emails, online resources, physiological monitoring. Consideration needs to be given to the mode of delivery and the stroke survivor and their areas of challenge. For example, a person may have difficulty speaking on a telephone, but may be able to communicate easily using vidoeconferencing.

Interventions that were included in the Laver et al (2020)*[64]* Cochrane review which have also been shown to produce significant effects face to face, as described in topics throughout these guidelines, are listed below and should be the focus of any such services. Further research for other topics not covered is needed.

Activities of daily living

- repetitive task practice
- physical exercise and electromyography-triggered neuromuscular stimulation

Balance (sitting or standing)

- repetitive, task practice
- virtual reality in addition to conventional therapy
- physical exercise plus electromyography-triggered neuromuscular stimulation

Upper limb function (measured with Fugl-Meyer Upper Extremity Scale)

- repetitive, task practice
- virtual reality

Communication (aphasia)

- Speech and language therapy (+/- via computer or tablet based)

Depression

- psychosocial behavioral interventions

Several of the trials in the Cochrane review (Laver et al 2020) compared various follow up support models (usually phone follow up) compared to usual or no care. It is unclear what benefits 'usual care' has and as such more research is needed to better understand specific interventions that are beneficial and if telehealth as a model of delivery is equivalent.

There is a risk that, without in-person supervision, a person may do the incorrect task without realising it or be unsafe. Therefore, it may be beneficial to undertake some in-person supervised sessions initially, before commencing telehealth interventions.

Some disciplines, for example, Psychology, have been successfully providing services via telehealth for a number of years already, and in those instances, telehealth is already viewed as a normal and effective mode of treatment, along with the face to face approach.

Evidence To Decision

Benefits and harms

Small net benefit, or little difference between alternatives

Telehealth rehabilitation achieves similar outcomes to in-person therapy after hospital discharge. No serious trial-related adverse events were reported.

Certainty of the Evidence

Low

Certainty of evidence is low to moderate.

Values and preferences

Substantial variability is expected or uncertain

Several studies have reported similar satisfaction in care or health related quality with telehealth rehabilitation compared to in-person clinics or usual care, and it is expected that some people will still prefer the direct human interaction while others will prefer the increased convenience and accessibility while in the comfort of their home. Specific interventions are similarly delivered via telehealth rehabilitation or in-person and we therefore don't expect significant variation in values and preferences. However, telehealth rehabilitation services may also mean some people can access services that are not available in-person, which they are likely to prefer to no therapy.

Resources

Important issues, or potential issues not investigated

No formal cost-effectiveness studies have been reported, however, five studies reported similar outcomes related to health service utilisation or costs between usual care and telehealth rehabilitation interventions. One study (Llorens et al 2015) calculated a cost savings of $655 per participant in the telehealth rehabilitation intervention.

Equity

Important issues, or potential issues not investigated

Telehealth rehabilitation services can increase equity of access to rehabilitation after stroke, especially in rural and remote areas. However, they can also increase inequity for people who do not have access to the necessary software or hardware or access to the internet, or for people who need assistance navigating those sorts of technology.

Acceptability

No important issues with the recommended alternative

Telehealth rehabilitation interventions are becoming more common and we believe it is acceptable for both people with stroke and care providers. Studies generally report no difference in satisfaction compared to in-person care or usual care.

Feasibility

Important issues, or potential issues not investigated

There is significant variation in interventions used and software/equipment needed. Technology varied from simple telephone use or videoconferencing which is widely used now (particularly as a result of the COVID-19 pandemic).

Rationale

Telehealth is an important emerging mode of delivering stroke rehabilitation. Many interventions have tested telehealth compared to face-to-face delivery and found equivalent outcomes. (Laver et al 2020*[64]*; Knepley et al 2020*[399]*; Tchero et al 2018*[404]*). It is important to recognise the actual interventions tested and ensure these are clearly beneficial for patient outcomes as telehealth is simply a mode of delivery rather than an intervention.

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Telerehabilitation
Comparator: in-person rehabilitation

Summary

Laver et al (2020)*[64]* included 22 studies (n=1937) comparing telehealth rehabilitation to therapy provided face-to-face. Most interventions had six or less studies pooled, and quality ranged from low to moderate. Overall telehealth rehabilitation was found to have similar outcomes for activities of daily living (ADL), balance, health related quality of life, depression and arm function. Care may be less expensive to provide but further evidence is required. No serious adverse events have been noted.

Other systematic reviews are generally consistent.

Knepley et al (2020)*[399]* included 34 studies (n=1,025) but only 15 of these were RCT. All studies reported improvements in the telehealth rehabilitation group and showed equivalent or better functional outcomes compared to traditional (in-person therapy). Patient satisfaction was similar.

Appleby et al (2019)*[400]* included 13 studies (n=355). No meta-analysis was undertaken. Interventions and outcomes were noted to vary. Telehealth rehabilitation may be as effective as usual care for motor function, ADLs, independence and self-efficacy and patient satisfaction.

Schroder et al (2019)*[401]* included seven studies (n=120) of which four were RCTs. Telehealth rehabilitation incorporating virtual reality training appeared to be similar to therapist-supervised intervention for balance and walking outcomes.

Tchero et al (2018)*[404]* included 15 studies (n=1339). Pooling 12 studies found no significant difference in regards to ADL (Barthel Index SMD -0.05, 95% CI -0.18 to 0.08), balance (Berg Balance Scale SMD -0.04, 95% CI -0.34 to 0.26), arm impairment (Fugl-Meyer Upper Extremity SMD 0.50, 95% CI -0.09 to 1.09), and walking ability (Stroke Impact Scale mobility subscale; SMD 0.18, 95% CI -0.13 to 0.48]). There appeared no difference regarding health-related quality of life (of stroke survivors), Caregiver Strain Index, and patients' satisfaction with care. One study found the cost of telehealth rehabilitation was lower than usual care by US $867.

Sarfo et al (2018)*[402]* included 22 studies but did not undertake meta-analysis. Seven studies were noted to report significant improvements compared to controls with the remainder reporting no differences between intervention and control for primary or secondary outcomes.

Nordio et al (2018)*[405]* included one study that found adherence to treatment improved for patients with dysphagia receiving telehealth rehabilitation compared with in-person sessions. Further studies are needed.

Chen et al (2015)*[403]* included 11 studies. The pooled results of seven studies showed no significant differences in ADL (Barthel Index SMD -0.05, 95% CI -0.24 to 0.13) balance (Berg Balance Scale: SMD -0.05, 95% CI -0.7 to 0.37) and arm impairment (Fugl-Meyer Extremity: SMD 0.05, 95% CI -0.09 to 1.09) between groups.

Saywell et al (2021)*[409]* assessed the effect of a 6 month Augmented Community Telerehabilitation Intervention (ACTIV) involving 95 people with first ever stroke. In the intervention group each participant received four visits in their home, five structured phone calls, and intermittent personalized text messages. The intervention group received 14 hours of contact over 6 months, of which 9 hours were delivered remotely. There was a non-significant trend in improvements in the physical subcomponent of the Stroke Impact Scale at the end of the intervention (4.51; 95% CI -0.46 to 9.48; P = .07). Results were significant in per-protocol analysis when at least 50% of the intervention was provided (4.98, 95%CI 0.003 to 9.95; P = 0.05). There was no difference between groups at the 12-month follow up.

Subsequent studies specifically for communication therapy are also consistent with results reporting equivalent or better outcomes than the alternative delivery methods.

Ora et al (2020)*[408]* included people with aphasia after stroke (n=62) and tested usual face-to-face speech therapy compared to usual therapy plus additional therapy delivered via telehealth rehabilitation. No significant between-group differences were seen in naming or auditory comprehension in the Norwegian Basic Aphasia Assessment at four weeks and four months. It is noted this trial tested using telehealth rehabilitation to substantially increase therapy provided so it is unclear if the effects are due to the mode of additional therapy (telehealth rehabilitation) or just the additional therapy (5 hours per week for 4 weeks).

Maresca et al (2019)*[407]* included 30 people in subacute care with aphasia. The trial was conducted over two phases: firstly an inpatient phase used the tablet based virtual reality intervention compared to usual care, then in the second phase

telehealth rehabilitation was compared to usual in-person therapy. The intervention group was reported to improve on all outcome measures whereas the usual care group improved on some outcomes. The same authors completed a similar study (Torrisi et al 2019*[410]*) with 40 people with cognitive difficulties. The second phase included 3x50 minute sessions weekly and found similar or better results using telehealth rehabilitation model compared with in-person sessions.

Outcome Timeframe	**Study results and measurements**	**Comparator** in-person rehabilitation	**Intervention** Telerehabilitation	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Activities of daily living 7 Critical	Measured by: Barthel Index Scale: 0 — 100 Based on data from 75 participants in 2 studies. [1] (Randomized controlled) Follow up: post-intervention.	Difference:	**MD 0.59 higher** (CI 95% 5.5 lower — 6.68 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [2]	Telerehabilitation probably leads to similar outcomes on activities of daily living compared to in-person rehabilitation
Balance 7 Critical	Measured by: Berg Balance Scale Scale: 0 — 56 Based on data from 106 participants in 3 studies. [3] (Randomized controlled) Follow up: post-intervention.	Difference:	**MD 0.48 higher** (CI 95% 1.36 lower — 2.32 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [4]	Telerehabilitation probably leads to similar outcomes on balance compared to in-person rehabilitation
Upper limb function 7 Critical	Measured by: Fugl Meyer Assessment Based on data from 170 participants in 3 studies. [5] (Randomized controlled) Follow up: post-intervention.	Difference:	**MD 1.23 higher** (CI 95% 2.17 lower — 4.64 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [6]	Telerehabilitation probably leads to similar outcomes on upper limb function compared to in-person rehabilitation
Functional communication 7 Critical	Measured by: Western Aphasia Battery aphasia quotient and Cognitive Linguistic Quick Test Based on data from 30 participants in 1 studies. [7] (Randomized controlled)	Difference:	**MD 1.1 higher** (CI 95% 2.52 lower — 4.72 higher)	**Very low** Due to very serious risk of bias [8]	Telerehabilitation probably leads to similar outcomes on functional communication

1. Systematic review [63] with included studies: Chen 2017, Lin 2014. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients, Wide confidence intervals. **Publication bias: no serious.**
3. Systematic review [63] with included studies: Lin 2014, Chen 2017, Llorens 2015. **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Wide confidence intervals, Low number of patients. **Publication bias: no serious.**
5. Systematic review [63] with included studies: Piron 2008, Cramer 2019, Piron 2009. **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients, Wide confidence intervals. **Publication bias: no serious.**

7. Systematic review [63] with included studies: Meltzer 2018. **Baseline/comparator:** Control arm of reference used for intervention.
8. **Risk of Bias: very serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Only data from one study, Low number of patients.

Attached Images

Clinical Question/ PICO

Population: Adults with stroke
Intervention: Telerehabilitation for post hospital discharge support
Comparator: Usual care or no rehab

Summary

Laver et al (2020)*[283]* included 22 studies (n=1937). Ten studies compared telehealth rehabilitation after hospital discharge with usual care available to clients of the service (often limited or no care provided). Overall telehealth rehabilitation was found to have similar outcomes for ADL (2 studies, n=661), mobility (1 study, n=144), health related quality of life (3 studies, n=569), depression (6 studies, n=1145), and arm function (2 studies, n=54). Care may be less expensive to provide but further evidence is required. No serious adverse events have been noted.

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Telerehabilitation for post hospital support	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
Activities of daily living 7 Critical	Measured by: Barthel Index Based on data from 661 participants in 2 studies. [1] (Randomized controlled) Follow up: post-intervention.	Difference:	**SMD 0 lower** (CI 95% 0.15 lower — 0.15 higher)	**Moderate** Due to serious risk of bias [2]	Telerehabilitation led to similar outcomes on activities of daily living compared to usual care
Gait speed 7 Critical	Measured by: Gait speed Based on data from 190 participants in 1 studies. [3] (Randomized controlled) Follow up: post-intervention.	Difference:	**MD 0.01 higher** (CI 95% 0.12 lower — 0.14 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [4]	Telerehabilitation led to similar outcomes on gait speed compared to usual care
Health-related quality of life 7 Critical	Measured by: Various (EQ5D and WHOQOL-BREF) Based on data from 569 participants in 3 studies. [5] (Randomized controlled) Follow up: post-intervention.	Difference:	**SMD 0.03 higher** (CI 95% 0.14 lower — 0.2 higher)	**Moderate** Due to serious risk of bias [6]	Telerehabilitation probably leads to similar outcomes on health-related quality of life compared to usual care
Depression [7]	Measured by: Various depression scales	Difference:	**SMD 0.04 lower** (CI 95% 0.19 lower — 0.11	**Moderate** Due to serious risk of bias [9]	Telerehabilitation probably leads to similar outcomes on depression

Outcome Timeframe	**Study results and measurements**	**Comparator** Usual care	**Intervention** Telerehabilitation for post hospital support	**Certainty of the Evidence** (Quality of evidence)	**Plain language summary**
7 Critical	Based on data from 1,145 participants in 6 studies. [8] (Randomized controlled) Follow up: post-intervention.		higher)		compared to usual care
Upper limb function [10] 7 Critical	Measured by: Various Based on data from 54 participants in 2 studies. [11] (Randomized controlled) Follow up: post-intervention.	Difference:	**SMD 0.33 higher** (CI 95% 0.21 lower — 0.87 higher)	**Low** Due to serious risk of bias, Due to serious imprecision [12]	Telerehabilitation probably leads to similar outcomes on arm function compared to usual care

1. Systematic review [63] with included studies: Mayo 2008, Boter 2004. **Baseline/comparator:** Control arm of reference used for intervention.
2. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
3. Systematic review [63] with included studies: Mayo 2008. **Baseline/comparator:** Control arm of reference used for intervention.
4. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Only data from one study, Low number of patients.
5. Systematic review [63] with included studies: Saal 2015, Rochette 2013, Mayo 2008. **Baseline/comparator:** Control arm of reference used for intervention.
6. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
7. Studies included Hospital depression scale, Hamilton rating scale for depression, Geriatric depression scale, Becks depression inventory and CES-D
8. Systematic review [63] with included studies: Smith 2012, Saal 2015, Kirkness 2017, Boter 2004, Rochette 2013, Mayo 2008. **Baseline/comparator:** Control arm of reference used for intervention.
9. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: no serious. Publication bias: no serious.**
10. One study used Fugl Meyer and one used Late-Life Function and Disability Instrument: upper extremity function
11. Systematic review [63] with included studies: Chumbler 2012, Bizovičar 2017. **Baseline/comparator:** Control arm of reference used for intervention.
12. **Risk of Bias: serious. Inconsistency: no serious. Indirectness: no serious. Imprecision: serious.** Low number of patients. **Publication bias: no serious.**

Attached Images

Glossary and abbreviations

Glossary

Activities of daily living: The basic elements of personal care such as eating, washing and showering, grooming, walking, standing up from a chair and using the toilet.
Activity: The execution of a task or action by an individual. Activity limitations are difficulties an individual may have in executing activities.
Agnosia: The inability to recognise sounds, smells, objects or body parts (other people's or one's own) despite having no primary sensory deficits.
Aphasia: Impairment of language, affecting the production or comprehension of speech and the ability to read and write.
Apraxia: Impaired planning and sequencing of movement that is not due to weakness, incoordination or sensory loss.
Apraxia of speech: Inability to produce clear speech due to impaired planning and sequencing of movement in the muscles used for speech.
Atrial fibrillation: Rapid, irregular beating of the heart.
Augmentative and alternative communication: Non-verbal communication, e.g. through gestures or by using computerised devices.
Central register: collection of large dataset related to patients' diagnoses, treatments and outcomes
Cochrane: Cochrane is a worldwide, not-for-profit organisation that produces systematic reviews of medical research. Systematic reviews summarise all the research that has been done on a given topic, so that health professionals, patients and policy-makers can make evidence-based decisions.
Cochrane are partnering with the Stroke Foundation on the Living Stroke Guidelines project.
Cochrane review: a comprehensive systematic review and meta-analysis published online in Cochrane library, internationally recognized as the highest standard in evidence-based health care resources
Conflict of Interest (COI) form: A conflict of interest form is signed by all working group members (including all members of the consumer panel). It highlights whether there is any risk of the person's professional judgement (eg. their assessment of research) being influenced by a secondary interest they may have, such as financial gain or career advancement.
Covidence: Covidence is computer software that Cochrane uses to help identify research for systematic reviews. It reduces the workload by allowing the person using it to quickly scan-read and screen scientific papers for relevance, make a summary of their main findings, and assess how well the research was done and whether there is a risk of bias.
Covidence will be used to screen all stroke-related research articles so that only the most accurate ones go into the Living Stroke Guidelines.
Deep vein thrombosis: Thrombosis (a clot of blood) in the deep veins of the leg, arm, or abdomen.
Disability: A defect in performing a normal activity or action (e.g. inability to dress or walk).
Drip and ship: A model of thrombolysis service provision that involves assessment of patients at a non-specialist centres with telemedicine support by stroke specialists, commencing thrombolysis (if deemed appropriate) and subsequent transfer to the stroke specialist centre.
Dyad: involvement of both patients and their caregivers
Dysarthria: Impaired ability to produce clear speech due to the impaired function of the speech muscles.
Dysphagia: Difficulty swallowing.
Dysphasia: Reduced ability to communicate using language (spoken, written or gesture).
Emotionalism: An increase in emotional behaviour—usually crying, but sometimes laughing that is outside normal control and may be unpredictable as a result of the stroke.
Endovascular thrombectomy (also called mechanical thrombectomy or endovascular clot retrieval): a minimally invasive procedure performed via angiogram, in which a catheter passes up into the brain to remove the clot in the blocked blood vessel.
Enteral tube feeding: Delivery of nutrients directly into the intestine via a tube.
Evaluation (of project): An evaluation is an assessment of a project. The aim of an evaluation is to determine the project's effectiveness, efficiency, impact and sustainability.
Evidence-based decision-making: Evidence-based decision-making is a process for making decisions about an intervention, practice etc, that is grounded in the best available research evidence.
Evidence summary: An evidence summary is a short summary of the best available evidence for a particular (guidelines') question. It aims to help clinicians use the best available evidence in their decision-making about particular interventions.
Executive function: Cognitive functions usually associated with the frontal lobes including planning, reasoning, time perception, complex goal-directed behaviour, decision making and working memory.
Family support / liaison worker: A person who assists stroke survivors and their families to achieve improved quality of life by providing psychosocial support, information and referrals to other stroke service providers.
GRADE: The GRADE approach (Grading of Recommendations Assessment, Development and Evaluation) is a standardised way of assessing research (also known as the *quality of evidence*) and determining the strength of recommendations. It was designed to be transparent and rigorous and has become the leading method used for guideline development.
GRADE will be applied to the Living Stroke Guidelines to ensure that their recommendations are accurate and robust.
Impairment: A problem in the structure of the body (e.g. loss of a limb) or the way the body or a body part functions (e.g. hemiplegia).

Infarction: Death of cells in an organ (e.g. the brain or heart) due to lack of blood supply.
InformMe: InformMe is the Stroke Foundation's dedicated website for health professionals working in stroke care.
Inpatient stroke care coordinator: A person who works with people with stroke and with their carers to construct care plans and discharge plans and to help coordinate the use of healthcare services during recovery in hospital.
Interdisciplinary team: group of health care professionals (including doctors, nurses, therapists, social workers, psychologists and other health personnel) working collaboratively for the common good of the patient.
Ischaemia: An inadequate flow of blood to part of the body due to blockage or constriction of the arteries that supply it.
Neglect: The failure to attend or respond to or make movements towards one side of the environment.
MAGICapp: MAGICapp is an online platform for writing (authoring) and publishing guidelines and evidence summaries. MAGIC stands for MAking GRADE the Irresistible Choice.
The platform guides authors through the different stages of planning, authoring, and publishing of information. It then publishes the guidelines online for clinicians and their patients to access. People can dig as deep into the information as they need, in order to make well-informed healthcare decisions.
MAGICapp is the technology that will be used to write and publish the Living Stroke Guidelines.
Neglect: The failure to attend or respond to or make movements towards one side of the environment.
NHMRC: The National Health and Medical Research Council (NHMRC) is the Australian Government agency that provides most of the funding for medical research. It develops health advice for the Australian community, health professionals and governments, and develops and maintains health standards. It also provides advice on ethical behaviour in health care and in conducting health and medical research.
The NHMRC are responsible for approving the stroke clinical guidelines.
Participation: Involvement in a life situation.
Participation restrictions: Problems an individual may experience in involvement in life situations.
Penumbral-based imaging: brain imaging that uses advanced MRI or CT angiography imaging to detect parts of the brain where the blood supply has been compromised but the tissue is still viable.
Percutaneous endoscopic gastrostomy (PEG): A form of enteral feeding in which nutrition is delivered via a tube that is surgically inserted into the stomach through the skin.
Pharmaceutical Benefits Scheme (PBS): A scheme whereby the costs of prescription medicine are subsidised by the Australian Government to make them more affordable.
Phonological deficits: Language deficits characterised by impaired recognition and/or selection of speech sounds.
PICO: PICO is a common way to define what research you are looking for to answer a clinical or healthcare question. Each systematic review of research is based on a specific PICO, or group of similar PICOs. PICO stands for:
P – patient, problem or population
I – intervention
C – comparison, control or comparator
O – outcome.
For example, for the question, "does care on a stroke unit improve outcomes for people with stroke?" the PICO is:
P: all people with stroke
I: care on a dedicated stroke unit (the systematic review defines what a stroke unit actually is)
C: care on a general ward
O: death, institutionalisation rate, dependency by the end of a defined follow-up period, or length of stay in a hospital or institution
Each recommendation in the Living Stroke Guidelines will be broken down into its PICO components. The scientific papers searched will need to match as closely to the PICO elements as possible.
Public consultation: Public consultation is a process by which the public's input on matters affecting them is sought. Its main goals are to improve the efficiency, transparency , and public involvement, in a project – in this case in the update of the stroke guidelines.
Pulmonary embolism: Blockage of the pulmonary artery (which carries blood from the heart to the lungs) with a solid material, usually a blood clot or fat, that has travelled there via the circulatory system.
Qualitative research: Qualitative research is about words. It aims to answer questions of 'why'. It is best used to explore perspectives, attitudes and reasons.
Quantitative research: Quantitative research is about numbers. It is best used to answer questions of 'what' or 'how many'.
Randomised control trial: A controlled trial is a clinical study that compares the results of a group of people receiving a new treatment that is under investigation, against a group receiving a placebo treatment, the existing standard treatment, or no treatment at all. These comparison groups are examples of 'control' groups.
Rehabilitation: Restoration of the disabled person to optimal physical and psychological functional independence.
Research Ethics Committee: A Research Ethics Committee is a group that reviews all research proposals involving human participants to ensure that the proposals are ethically acceptable.
Research wastage:
Risk factor: A characteristic of a person (or people) that is positively associated with a particular disease or condition.
Retiring (a question): A guidelines' question is 'retired' when it is removed from the guidelines' list – this means that we will no longer search for new research (evidence) for that particular question.
Stroke unit: A section of a hospital dedicated to comprehensive acute and/or rehabilitation programs for people with a stroke.

Stroke: Sudden and unexpected damage to brain cells that causes symptoms that last for more than 24 hours in the parts of the body controlled by those cells. Stroke happens when the blood supply to part of the brain is suddenly disrupted, either by blockage of an artery or by bleeding within the brain.
Systematic review: Systematic reviews summarise all the research that has been done on a given topic, so that health professionals, patients and policy-makers can make evidence-based decisions.
Task-specific training: Training that involves repetition of a functional task or part of the task.
Transient ischaemic attack: Stroke-like symptoms that last less than 24 hours. While TIA is not actually a stroke, it has the same cause. A TIA may be the precursor to a stroke, and people who have had a TIA require urgent assessment and intervention to prevent stroke.

Abbreviations

ACE	Angiotensin-converting enzyme
ADL	Activities of daily living
AF	Atrial fibrillation
AFO	Ankle foot orthosis
BAO	Basilar artery occlusion
BI	Barthel Index
BMI	Body mass index
BP	Blood pressure
CEA	Carotid endarterectomy
CEMRA	Contrast-enhanced magnetic resonance angiography
CI	Confidence interval
CIMT	Constraint induced movement therapy
CT	Computed tomography
CTA	Computed tomography angiography
CVD	Cardiovascular disease
DALY	Disability-adjusted life years
DBP	Diastolic blood pressure
DOAC	Direct oral anticoagulant
DSA	Digital subtraction angiography
DUS	Doppler ultrasonography
DVT	Deep vein thrombosis
DWI	Diffusion-weighted imaging
ECG	Electrocardiography
ED	Emergency department
EMG	Electromyographic feedback
EMS	Emergency medical services
ESD	Early supported discharge
ESS	European Stroke Scale
FAST	Face, Arm, Speech, Time

FEES	Fibre-optic endoscopic examination of swallowing
FeSS	Fever, Sugar, Swallowing
FFP	Fresh frozen plasma
FIM	Functional independence measure
GP	General practitioner
HR	Hazard ratio
HRQOL	Health related quality of life
HRT	Hormone replacement therapy
IA	Intra-arterial
ICH	Intracerebral haemorrhage
ICU	Intensive care unit
INR	International normalised ratio
IPC	Intermittent pneumatic compression
IV	Intravenous
LMWH	Low molecular weight heparin
LOS	Length of stay
MCA	Middle cerebral artery
MD	Mean difference
MI	Myocardial infarction
MNA	Mini Nutritional Assessment
MR	Magnetic resonance
MRA	Magnetic resonance angiography
MRI	Magnetic resonance imaging
mRS	Modified rankin scale
MST	Malnutrition screening tool
MUST	Malnutrition universal screening tool
N	Number of participants in a trial
NASCET	North American Symptomatic Carotid Endarterectomy Trial
NG	Nasogastric
NHMRC	National Health and Medical Research Council
NIHSS	National Institutes of Health Stroke Scale
NMES	Neuromuscular electrical stimulation
NNH	Numbers needed to harm
NNT	Numbers needed to treat
OR	Odds ratio

OT	Occupational therapist
PBS	Pharmaceutical Benefits Scheme
PE	Pulmonary embolism
PEG	Percutaneous endoscopic gastrostomy
PFO	Patent foramen ovale
PPV	Positive predictive value
QALYs	Quality-adjusted life years
QOL	Quality of life
RCT	Randomised controlled trial
rFVIIa	recombinant activated factor VII
RHS	Right hemisphere syndrome
ROC	Receiver operator curve
ROM	Range of motion
ROSIER	Recognition of stroke in the emergency room
RR	Relative risk
RRR	Relative risk reduction
rTMS	repetitive transcranial magnetic stimulation
rt-PA	Recombinant tissue plasminogen activator
SBP	Systolic blood pressure
SC	Subcutaneous
SD	Standard deviation
SE	Standard error
SES	Standardised effect size
SGA	Subjective global assessment
sICH	symptomatic intracerebral haemorrhage
SMD	Standardised mean difference
SSS	Scandinavian stroke scale
TEE	Transoesophageal echocardiography
TIA	Transient ischaemic attack
TOE	Transoesophageal echocardiography
TOR-BSST	Toronto Bedside Swallowing Screening test
tPA	Tissue plasmogen activator
TTE	Transthoracic echocardiography
UFH	Unfractionated heparin
UK	United Kingdom

UL	Upper limb
VF or VFS	Videofluoroscopy
VR	Virtual reality
VTE	Venous thromboembolism
WMD	Weighted mean difference

References

1. Thrift AG, Hayman N : Aboriginal and Torres Strait Islander peoples and the burden of stroke. International journal of stroke : official journal of the International Stroke Society 2007;2(1):57-9 Pubmed Journal

2. National Stroke Foundation : National Stroke Unit Program. Aboriginal Stroke Project. 2003;

3. Kilkenny MF, Harris DM, Ritchie EA, Price C, Cadilhac DA, : Hospital management and outcomes of stroke in Indigenous Australians: evidence from the 2009 Acute Care National Stroke Audit. International journal of stroke : official journal of the International Stroke Society 2013;8(3):164-71 Pubmed Journal

4. Australian Institute of Health and Welfare : Stroke and its management in Australia: an update. 2013;

5. National Vascular Disease Prevention Alliance : Guidelines for the management of absolute cardiovascular disease risk. 2012;

6. Heart Foundation : Guideline for the diagnosis and management of hypertension in adults. 2016;

7. Stroke Foundation : National Stroke Audit - Acute Services Report 2019.

8. Stroke Foundation : National Stroke Audit - Rehabilitation Services Report 2020. 2020;

9. Bernhardt J, Langhorne P, Lindley RI, Thrift AG, Ellery F, Collier J, et al. : Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): a randomised controlled trial. Lancet (London, England) 2015;386(9988):46-55 Pubmed Journal

10. Lynch E, Hillier S, Cadilhac D : When should physical rehabilitation commence after stroke: a systematic review. International journal of stroke : official journal of the International Stroke Society 2014;9(4):468-78 Pubmed Journal

11. Langhorne P, Stott D, Knight A, Bernhardt J, Barer D, Watkins C : Very early rehabilitation or intensive telemetry after stroke: a pilot randomised trial. Cerebrovascular diseases (Basel, Switzerland) 2010;29(4):352-60 Pubmed Journal

12. Bernhardt J, Churilov L, Ellery F, Collier J, Chamberlain J, Langhorne P, et al. : Prespecified dose-response analysis for A Very Early Rehabilitation Trial (AVERT). Neurology 2016;86(23):2138-45 Pubmed Journal

13. Langhorne P, Ramachandra S, Stroke Unit Trialists' Collaboration : Organised inpatient (stroke unit) care for stroke: network meta-analysis. The Cochrane database of systematic reviews 2020;4(4):CD000197 Pubmed Journal

14. Rethnam V, Langhorne P, Churilov L, Hayward KS, Herisson F, Poletto SR, et al. : Early mobilisation post-stroke: a systematic review and meta-analysis of individual participant data. Disability and rehabilitation 2020; 1-8 Pubmed Journal

15. Langhorne P, Collier JM, Bate PJ, Thuy MN, Bernhardt J : Very early versus delayed mobilisation after stroke. The Cochrane database of systematic reviews 2018;10 CD006187 Pubmed Journal

16. Cumming TB, Churilov L, Collier J, Donnan G, Ellery F, Dewey H, et al. : Early mobilization and quality of life after stroke: Findings from AVERT. Neurology 2019;93(7):e717-e728 Pubmed Journal

17. Gao L, Sheppard L, Wu O, Churilov L, Mohebbi M, Collier J, et al. : Economic evaluation of a phase III international randomised controlled trial of very early mobilisation after stroke (AVERT). BMJ open 2019;9(5):e026230 Pubmed Journal

18. Faulkner J, Stoner L, Lanford J, Jolliffe E, Mitchelmore A, Lambrick D : Long-Term Effect of Participation in an Early Exercise and Education Program on Clinical Outcomes and Cost Implications, in Patients with TIA and Minor, Non-Disabling Stroke. Translational stroke research 2017;8(3):220-227 Pubmed Journal

19. Serrada I, McDonnell MN, Hillier SL : What is current practice for upper limb rehabilitation in the acute hospital setting following stroke? A systematic review. NeuroRehabilitation 2016;39(3):431-8 Pubmed Journal

20. Yen H-C, Jeng J-S, Chen W-S, Pan G-S, Chuang Pt Bs W-Y, Lee Y-Y, et al. : Early Mobilization of Mild-Moderate Intracerebral Hemorrhage Patients in a Stroke Center: A Randomized Controlled Trial. Neurorehabilitation and neural repair 2020;34(1):72-81 Pubmed Journal

21. Wang F, Zhang S, Zhou F, Zhao M, Zhao H : Early physical rehabilitation therapy between 24 and 48 h following acute ischemic stroke onset: a randomized controlled trial. Disability and rehabilitation 2021; 1-6 Pubmed Journal

22. Scrivener K, Jones T, Schurr K, Graham PL, Dean CM : After-hours or weekend rehabilitation improves outcomes and increases physical activity but does not affect length of stay: a systematic review. Journal of physiotherapy 2015;61(2):61-67 Pubmed Journal

23. English C, Bernhardt J, Crotty M, Esterman A, Segal L, Hillier S : Circuit class therapy or seven-day week therapy for increasing rehabilitation intensity of therapy after stroke (CIRCIT): a randomized controlled trial. International journal of stroke : official journal of the International Stroke Society 2015;10(4):594-602 Pubmed Journal

24. Veerbeek JM, van Wegen E, van Peppen R, van der Wees PJ, Hendriks E, Rietberg M, et al. : What is the evidence for physical therapy poststroke? A systematic review and meta-analysis. PloS one 2014;9(2):e87987 Pubmed Journal

25. Pollock A, Farmer SE, Brady MC, Langhorne P, Mead GE, Mehrholz J, et al. : Interventions for improving upper limb function after stroke. The Cochrane database of systematic reviews 2014;(11):CD010820 Pubmed Journal

26. Lohse KR, Lang CE, Boyd LA : Is more better? Using metadata to explore dose-response relationships in stroke rehabilitation. Stroke; a journal of cerebral circulation 2014;45(7):2053-2058 Pubmed Journal

27. Hayward KS, Barker RN, Carson RG, Brauer SG : The effect of altering a single component of a rehabilitation programme on the functional recovery of stroke patients: a systematic review and meta-analysis. Clinical rehabilitation 2014;28(2):107-117 Pubmed Journal

28. Godecke E, Hird K, Lalor EE, Rai T, Phillips MR : Very early poststroke aphasia therapy: a pilot randomized controlled efficacy trial. International journal of stroke : official journal of the International Stroke Society 2012;7(8):635-644 Pubmed Journal

29. Veerbeek JM, Koolstra M, Ket JCF, van Wegen EEH, Kwakkel G : Effects of augmented exercise therapy on outcome of gait and gait-related activities in the first 6 months after stroke: a meta-analysis. Stroke; a journal of cerebral circulation 2011;42(11):3311-3315 Pubmed Journal

30. Peiris CL, Taylor NF, Shields N : Extra physical therapy reduces patient length of stay and improves functional outcomes and quality of life in people with acute or subacute conditions: a systematic review. Archives of physical medicine and rehabilitation 2011;92(9):1490-1500 Pubmed Journal

31. Winstein CJ, Wolf SL, Dromerick AW, Lane CJ, Nelsen MA, Lewthwaite R, et al. : Effect of a Task-Oriented Rehabilitation Program on Upper Extremity Recovery Following Motor Stroke: The ICARE Randomized Clinical Trial. JAMA 2016;315(6):571-81 Pubmed Journal

32. Schneider EJ, Lannin NA, Ada L, Schmidt J : Increasing the amount of usual rehabilitation improves activity after stroke: a systematic review. Journal of Physiotherapy 2016; Journal Website

33. English C, Shields N, Brusco NK, Taylor NF, Watts JJ, Peiris C, et al. : Additional weekend therapy may reduce length of rehabilitation stay after stroke: a meta-analysis of individual patient data. Journal of physiotherapy 2016;62(3):124-9 Pubmed Journal

34. Kaur G, English C, Hillier S : Physiotherapists systematically overestimate the amount of time stroke survivors spend engaged in active therapy rehabilitation: an observational study. Journal of physiotherapy 2013;59(1):45-51 Pubmed Journal

35. Luker J, Lynch E, Bernhardsson S, Bennett L, Bernhardt J : Stroke Survivors' Experiences of Physical Rehabilitation: A Systematic Review of Qualitative Studies. Archives of physical medicine and rehabilitation 2015;96(9):1698-708.e10 Pubmed Journal

36. English C, Veerbeek J : Is more physiotherapy better after stroke?. International journal of stroke : official journal of the International Stroke Society 2015;10(4):465-6 Pubmed Journal

37. English C, Bernhardt J, Hillier S : Circuit class therapy and 7-day-week therapy increase physiotherapy time, but not patient activity: early results from the CIRCIT trial. Stroke 2014;45(10):3002-7 Pubmed Journal

38. English C, Hillier S, Kaur G, Hundertmark L : People with stroke spend more time in active task practice, but similar time in walking practice, when physiotherapy rehabilitation is provided in circuit classes compared to individual therapy sessions: an observational study. Journal of physiotherapy 2014;60(1):50-4 Pubmed Journal

39. Langhorne P, Baylan S, Early Supported Discharge Trialists : Early supported discharge services for people with acute stroke. The Cochrane database of systematic reviews 2017;7 CD000443 Pubmed Journal

40. Larsen T, Olsen TS, Sorensen J : Early home-supported discharge of stroke patients: a health technology assessment. International journal of technology assessment in health care 2006;22(3):313-20 Pubmed

41. Saka O, Serra V, Samyshkin Y, McGuire A, Wolfe CCDA : Cost-effectiveness of stroke unit care followed by early supported discharge. Stroke 2009;40(1):24-9 Pubmed Journal

42. Patel A, Knapp M, Perez I, Evans A, Kalra L : Alternative strategies for stroke care: cost-effectiveness and cost-utility analyses from a prospective randomized controlled trial. Stroke; a journal of cerebral circulation 2004;35(1):196-203 Pubmed

43. Fjaertoft H, Indredavik B, Magnussen J, Johnsen R : Early supported discharge for stroke patients improves clinical outcome. Does it also reduce use of health services and costs? One-year follow-up of a randomized controlled trial. Cerebrovascular diseases (Basel, Switzerland) 2005;19(6):376-83 Pubmed

44. Tistad M, von Koch L : Usual Clinical Practice for Early Supported Discharge after Stroke with Continued Rehabilitation at Home: An Observational Comparative Study. PloS one 2015;10(7):e0133536 Pubmed Journal

45. Meyer M, Teasell R, Thind A, Koval J, Speechley M : A Synthesis of Peer-Reviewed Literature on Team-Coordinated and Delivered Early Supported Discharge After Stroke. Canadian Journal of Neurological Sciences / Journal Canadien des Sciences Neurologiques 2016/01/08;-1 1-7 Journal

46. Rafsten L, Danielsson A, Nordin A, Björkdahl A, Lundgren-Nilsson A, Larsson MEH, et al. : Gothenburg Very Early Supported Discharge study (GOTVED): a randomised controlled trial investigating anxiety and overall disability in the first year after stroke. BMC neurology 2019;19(1):277 Pubmed Journal

47. Fjærtoft H, Rohweder G, Indredavik B : Stroke unit care combined with early supported discharge improves 5-year outcome: a randomized controlled trial. Stroke 2011;42(6):1707-11 Pubmed Journal

48. Tam A, Mac S, Isaranuwatchai W, Bayley M : Cost-effectiveness of a high-intensity rapid access outpatient stroke rehabilitation program. International journal of rehabilitation research. 2019;42(1):56-62 Pubmed Journal

49. Walters R, Collier JM, Braighi Carvalho L, Langhorne P, Katijjahbe MA, Tan D, et al. : Exploring post acute rehabilitation service use and outcomes for working age stroke survivors (≤65 years) in Australia, UK and South East Asia: data from the international AVERT trial. BMJ open 2020;10(6):e035850 Pubmed Journal

50. Ghazipura M : Home-based versus centre-based rehabilitation for community- dwelling post acute stroke patients: a rapid review (Structured abstract). 2015; Website

51. Rasmussen RS, Østergaard A, Kjær P, Skerris A, Skou C, Christoffersen J, et al. : Stroke rehabilitation at home before and after discharge reduced disability and improved quality of life: a randomised controlled trial. Clinical rehabilitation 2016;30(3):225-36 Pubmed Journal

52. Doig E, Fleming J, Kuipers P, Cornwell PL : Comparison of rehabilitation outcomes in day hospital and home settings for people with acquired brain injury - a systematic review. Disability and rehabilitation 2010;32(25):2061-77 Pubmed Journal

53. Hillier S, Inglis-Jassiem G : Rehabilitation for community-dwelling people with stroke: home or centre based? A systematic review. International Journal of Stroke 2010;5(3):178-86 Pubmed Journal

54. Brusco NK, Taylor NF, Watts JJ, Shields N : Economic evaluation of adult rehabilitation: a systematic review and meta-analysis of randomized controlled trials in a variety of settings. Archives of physical medicine and rehabilitation 2014;95(1):94-116.e4 Pubmed Journal

55. Crotty M, Giles LC, Halbert J, Harding J, Miller M : Home versus day rehabilitation: a randomised controlled trial. Age and ageing 2008;37(6):628-33 Pubmed Journal

56. Andersson A, Levin L-A, Oberg B, Månsson L : Health care and social welfare costs in home-based and hospital-based rehabilitation after stroke. Scandinavian journal of caring sciences 2002;16(4):386-92 Pubmed

57. Beech R, Rudd AG, Tilling K, Wolfe CD : Economic consequences of early inpatient discharge to community-based rehabilitation for stroke in an inner-London teaching hospital. Stroke; a journal of cerebral circulation 1999;30(4):729-35 Pubmed

58. Gladman J, Whynes D, Lincoln N : Cost comparison of domiciliary and hospital-based stroke rehabilitation. DOMINO Study Group. Age and ageing 1994;23(3):241-5 Pubmed

59. McNamee P, Christensen J, Soutter J, Rodgers H, Craig N, Pearson P, et al. : Cost analysis of early supported hospital discharge for stroke. Age and Ageing 1998;27 (3):345 -351 Website

60. Roderick P, Low J, Day R, Peasgood T, Mullee MA, Turnbull JC, et al. : Stroke rehabilitation after hospital discharge: a randomized trial comparing domiciliary and day-hospital care. Age and ageing 2001;30(4):303-10 Pubmed

61. Young J, Forster A : Day hospital and home physiotherapy for stroke patients: a comparative cost-effectiveness study. Journal of the Royal College of Physicians of London 1993;27(3):252-8 Pubmed

62. Allen L, John-Baptiste A, Meyer M, Richardson M, Speechley M, Ure D, et al. : Assessing the impact of a home-based stroke rehabilitation programme: a cost-effectiveness study. Disability and rehabilitation 2019;41(17):2060-2065 Pubmed Journal

63. Telerehabilitation services for stroke [Data only. When citing this record quote "Cochrane Database of Systematic Reviews 2020, Issue 1".].

64. Laver KE, Adey-Wakeling Z, Crotty M, Lannin NA, George S, Sherrington C : Telerehabilitation services for stroke. The Cochrane database of systematic reviews 2020;1 CD010255 Pubmed Journal

65. Chen J, Jin W, Dong WS, Jin Y, Qiao FL, Zhou YF, et al. : Effects of Home-based Telesupervising Rehabilitation on Physical Function for Stroke Survivors with Hemiplegia: A Randomized Controlled Trial. American journal of physical medicine & rehabilitation 2017;96(3):152-160 Pubmed Journal

66. Chi N-F, Huang Y-C, Chiu H-Y, Chang H-J, Huang H-C : Systematic Review and Meta-Analysis of Home-Based Rehabilitation on Improving Physical Function Among Home-Dwelling Patients With a Stroke. Archives of Physical Medicine and Rehabilitation 2020;101(2):359-373 Journal Website

67. Wong Y, Ada L, Wang R, Månum G, Langhammer B : Self-administered, home-based, upper limb practice in stroke patients: A systematic review. Journal of rehabilitation medicine 2020;52(10):jrm00118 Pubmed Journal

68. Mandigout S, Chaparro D, Borel B, Kammoun B, Salle J-Y, Compagnat M, et al. : Effect of individualized coaching at home on walking capacity in subacute stroke patients: A randomized controlled trial (Ticaa'dom). Annals of physical and rehabilitation medicine 2020; Pubmed Journal

69. Nordin NAM, Aziz NA, Sulong S, Aljunid SM : Effectiveness of home-based carer-assisted in comparison to hospital-based therapist-delivered therapy for people with stroke: A randomised controlled trial. NeuroRehabilitation 2019;45(1):87-97 Pubmed Journal

70. Hsieh Y-W, Chang K-C, Hung J-W, Wu C-Y, Fu M-H, Chen C-C : Effects of Home-Based Versus Clinic-Based Rehabilitation Combining Mirror Therapy and Task-Specific Training for Patients With Stroke: A Randomized Crossover Trial. Archives of physical medicine and rehabilitation 2018;99(12):2399-2407 Pubmed Journal

71. Sugavanam T, Mead G, Bulley C, Donaghy M, van Wijck F : The effects and experiences of goal setting in stroke rehabilitation - a systematic review. Disability & Rehabilitation 2013;35(3):177-90 Journal Website

72. Taylor WJ, Brown M, William L, McPherson KM, Reed K, Dean SG, et al. : A pilot cluster randomized controlled trial of structured goal-setting following stroke. Clinical Rehabilitation 2012;26(4):327-38 Journal

73. Rosewilliam S., Roskell CA, Pandyan AD : A systematic review and synthesis of the quantitative and qualitative evidence behind patient-centred goal setting in stroke rehabilitation. Clinical rehabilitation 2011;25(6):501-514 Journal Website

74. Playford ED, Siegert R, Levack W, Freeman J : Areas of consensus and controversy about goal setting in rehabilitation: a conference report. Clinical rehabilitation 2009;23(4):334-44 Pubmed

75. Rodgers H, Howel D, Bhattarai N, Cant R, Drummond A, Ford GA, et al. : Evaluation of an Extended Stroke Rehabilitation Service (EXTRAS): A Randomized Controlled Trial and Economic Analysis. Stroke 2019;50(12):3561-3568 Pubmed Journal

76. Nagayama H, Tomori K, Ohno K, Takahashi K, Nagatani R, Izumi R, et al. : Cost effectiveness of the occupation-based approach for subacute stroke patients: result of a randomized controlled trial. Topics in stroke rehabilitation 2017;24(5):337-344 Pubmed Journal

77. Fishman KN, Ashbaugh AR, Swartz RH : Goal Setting Improves Cognitive Performance in a Randomized Trial of Chronic Stroke Survivors. Stroke 2021;52(2):458-470 Pubmed Journal

78. Nascimento LR, Michaelsen SM, Ada L, Polese JC, Teixeira-Salmela LF : Cyclical electrical stimulation increases strength and improves activity after stroke: a systematic review. Journal of physiotherapy 2014;60(1):22-30 Pubmed Journal

79. Jeon B-J, Kim W-H, Park E-Y : Effect of task-oriented training for people with stroke: a meta-analysis focused on repetitive or circuit training. Topics in stroke rehabilitation 2015;22(1):34-43 Pubmed Journal

80. Harris JE, Eng JJ : Strength training improves upper-limb function in individuals with stroke: a meta-analysis. Stroke; a journal of cerebral circulation 2010;41(1):136-40 Pubmed Journal

81. Ada L, Dorsch S, Canning CG : Strengthening interventions increase strength and improve activity after stroke: a systematic review. The Australian journal of physiotherapy 2006;52(4):241-8 Pubmed

82. de Sousa DG, Harvey LA, Dorsch S, Glinsky JV : Interventions involving repetitive practice improve strength after stroke: a systematic review. Journal of physiotherapy 2018;64(4):210-221 Pubmed Journal

83. Dorsch S, Ada L, Alloggia D : Progressive resistance training increases strength after stroke but this may not carry over to activity: a systematic review. Journal of physiotherapy 2018;64(2):84-90 Pubmed Journal

84. de Diego C, Puig S, Navarro X : A sensorimotor stimulation program for rehabilitation of chronic stroke patients. Restorative neurology and neuroscience 2013;31(4):361-71 Pubmed Journal

85. Doyle SD, Bennett S, Dudgeon B : Upper limb post-stroke sensory impairments: the survivor's experience. Disability and rehabilitation 2014;36(12):993-1000 Pubmed Journal

86. Carey L, Macdonell R, Matyas TA : SENSe: Study of the Effectiveness of Neurorehabilitation on Sensation: a randomized controlled trial. Neurorehabilitation and neural repair 2011;25(4):304-13 Pubmed Journal

87. Doyle S, Bennett S, Fasoli SE, McKenna KT : Interventions for sensory impairment in the upper limb after stroke. The Cochrane database of systematic reviews 2010;(6):CD006331 Pubmed Journal

88. Carey LM, Matyas TA : Training of somatosensory discrimination after stroke: facilitation of stimulus generalization. American journal of physical medicine & rehabilitation / Association of Academic Physiatrists 2005;84(6):428-42 Pubmed

89. Pumpa LU, Cahill LS, Carey LM : Somatosensory assessment and treatment after stroke: An evidence-practice gap. Australian occupational therapy journal 2015;62(2):93-104 Pubmed Journal

90. Lynch EA, Hillier SL, Stiller K, Campanella RR, Fisher PH : Sensory retraining of the lower limb after acute stroke: a randomized controlled pilot trial. Archives of physical medicine and rehabilitation 2007;88(9):1101-7 Pubmed

91. Serrada I, Hordacre B, Hillier SL : Does Sensory Retraining Improve Sensation and Sensorimotor Function Following Stroke: A Systematic Review and Meta-Analysis. Frontiers in neuroscience 2019;13 402 Pubmed Journal

92. Chia FS, Kuys S, Low Choy N : Sensory retraining of the leg after stroke: systematic review and meta-analysis. Clinical rehabilitation 2019;33(6):964-979 Pubmed Journal

93. Yilmazer C, Boccuni L, Thijs L, Verheyden G : Effectiveness of somatosensory interventions on somatosensory, motor and functional outcomes in the upper limb post-stroke: A systematic review and meta-analysis. NeuroRehabilitation 2019;44 459-477 Journal

94. Turville ML, Cahill LS, Matyas TA, Blennerhassett JM, Carey LM : The effectiveness of somatosensory retraining for improving sensory function in the arm following stroke: a systematic review. Clinical rehabilitation 2019;33(5):834-846 Pubmed Journal

95. Saunders DH, Sanderson M, Hayes S, Johnson L, Kramer S, Carter D, et al. : Physical fitness training for stroke patients. Cochrane Database of Systematic Reviews 2020; Pubmed Journal

96. Veerbeek JM, van Wegen E, van Peppen R, van der Wees PJ, Hendriks E, Rietberg M, et al. : What is the evidence for physical therapy poststroke? A systematic review and meta-analysis. PloS one 2014;9(2):e87987 Pubmed Journal

97. Pang MYC, Charlesworth SA, Lau RWK, Chung RCK : Using aerobic exercise to improve health outcomes and quality of life in stroke: evidence-based exercise prescription recommendations. Cerebrovascular diseases (Basel, Switzerland) 2013; Pubmed Journal

98. Nicholson S, Sniehotta FF, van Wijck F, Greig CA, Johnston M, McMurdo MET, et al. : A systematic review of perceived barriers and motivators to physical activity after stroke. International journal of stroke : official journal of the International Stroke Society 2013; Pubmed Journal

99. Billinger SA, Arena R, Bernhardt J, Eng JJ, Franklin BA, Johnson CM, et al. : Physical activity and exercise recommendations for stroke survivors: a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke; a journal of cerebral circulation 2014;45(8):2532-53 Pubmed Journal

100. Marsden DL, Dunn A, Callister R, Levi CR, Spratt NJ : Characteristics of exercise training interventions to improve cardiorespiratory fitness after stroke: a systematic review with meta-analysis. Neurorehabilitation and neural repair 2013;27(9):775-88 Pubmed Journal

101. Norton K, Norton L, Sadgrove D : Position statement on physical activity and exercise intensity terminology. Journal of science and medicine in sport / Sports Medicine Australia 2010;13(5):496-502 Pubmed Journal

102. English C, Manns PJ, Tucak C, Bernhardt J : Physical activity and sedentary behaviors in people with stroke living in the community: a systematic review. Physical therapy 2014;94(2):185-96 Pubmed Journal

103. Ivey FM, Macko RF, Ryan AS, Hafer-Macko CE : Cardiovascular health and fitness after stroke. Topics in stroke rehabilitation 2005;12(1):1-16 Pubmed

104. Polese JC : Cardiorespiratory Stress is not Achieved During Routine Physiotherapy in Chronic Stroke. International Journal of Physical Medicine & Rehabilitation 2014; Journal

105. Lee J, Stone AJ : Combined Aerobic and Resistance Training for Cardiorespiratory Fitness, Muscle Strength, and Walking Capacity after Stroke: A Systematic Review and Meta-Analysis. Journal of stroke and cerebrovascular diseases 2020;29(1):104498 Pubmed

Journal

106. Kuys S, Brauer S, Ada L : Routine physiotherapy does not induce a cardiorespiratory training effect post-stroke, regardless of walking ability. Physiotherapy research international : the journal for researchers and clinicians in physical therapy 2006;11(4):219-27 Pubmed

107. MacKay-Lyons MJ, Makrides L : Cardiovascular stress during a contemporary stroke rehabilitation program: is the intensity adequate to induce a training effect?. Archives of physical medicine and rehabilitation 2002;83(10):1378-83 Pubmed

108. Collins M, Clifton E, Wijck FV, Mead GE : Cost-effectiveness of physical fitness training for stroke survivors. The journal of the Royal College of Physicians of Edinburgh 2018;48(1):62-68 Pubmed Journal

109. Nave AH, Rackoll T, Grittner U, Bläsing H, Gorsler A, Nabavi DG, et al. : Physical Fitness Training in Patients with Subacute Stroke (PHYS-STROKE): multicentre, randomised controlled, endpoint blinded trial. BMJ 2019;366 l5101 Pubmed Journal

110. Veldema J, Jansen P : Ergometer Training in Stroke Rehabilitation: Systematic Review and Meta-analysis. Archives of physical medicine and rehabilitation 2020;101(4):674-689 Pubmed Journal

111. Lloyd M, Skelton DA, Mead GE, Williams B, van Wijck F : Physical fitness interventions for nonambulatory stroke survivors: A mixed-methods systematic review and meta-analysis. Brain and behavior 2018;8(7):e01000 Pubmed Journal

112. Boyne P, Welge J, Kissela B, Dunning K : Factors Influencing the Efficacy of Aerobic Exercise for Improving Fitness and Walking Capacity After Stroke: A Meta-Analysis With Meta-Regression. Archives of physical medicine and rehabilitation 2017;98(3):581-595 Pubmed Journal

113. Galloway M, Marsden DL, Callister R, Erickson KI, Nilsson M, English C : What Is the Dose-Response Relationship Between Exercise and Cardiorespiratory Fitness After Stroke? A Systematic Review. Physical therapy 2019;99(7):821-832 Pubmed Journal

114. Luo LU, Meng H, Wang Z, Zhu S, Yuan S, Wang Y, et al. : Effect of high-intensity exercise on cardiorespiratory fitness in stroke survivors: A systematic review and meta-analysis. Annals of physical and rehabilitation medicine 2020;63(1):59-68 Pubmed Journal

115. American College of Sports Medicine : ACSM's Guidelines for Exercise Testing and Prescription. Tenth edition. Philadelphia: Wolters Kluwer. 2018;

116. Pollock A, Hazelton C, Henderson CA, Angilley J, Dhillon B, Langhorne P, et al. : Interventions for visual field defects in patients with stroke. Cochrane Database of Systematic Review 2019; Pubmed Journal

117. Mödden C, Behrens M, Damke I, Eilers N, Kastrup A, Hildebrandt H : A randomized controlled trial comparing 2 interventions for visual field loss with standard occupational therapy during inpatient stroke rehabilitation. Neurorehabilitation and neural repair 2012;26(5):463-9 Pubmed Journal

118. Olma MC, Dargie RA, Behrens JR, Kraft A, Irlbacher K, Fahle M, et al. : Long-Term Effects of Serial Anodal tDCS on Motion Perception in Subjects with Occipital Stroke Measured in the Unaffected Visual Hemifield. Frontiers in human neuroscience 2013;7 314 Pubmed Journal

119. Cavanaugh MR, Blanchard LM, McDermott M, Lam BL, Tamhankar M, Feldon SE : Efficacy of Visual Retraining in the Hemianopic Field after Stroke: Results of a Randomized Clinical Trial. Ophthalmology 2020; Pubmed Journal

120. Hanna KL, Hepworth LR, Rowe FJ : The treatment methods for post-stroke visual impairment: A systematic review. Brain and behavior 2017;7(5):e00682 Pubmed Journal

121. Hanna KL, Rowe FJ : Clinical versus Evidence-based Rehabilitation Options for Post-stroke Visual Impairment. Neuro-ophthalmology (Aeolus Press) 2017;41(6):297-305 Pubmed Journal

122. Howard C, Rowe FJ : Adaptation to poststroke visual field loss: A systematic review. Brain and behavior 2018;8(8):e01041 Pubmed

Journal

123. Bank J, Charles K, Morgan P : What is the effect of additional physiotherapy on sitting balance following stroke compared to standard physiotherapy treatment: a systematic review. Topics in Stroke Rehabilitation 2016;23(1):15-25 Pubmed Journal

124. Chan BKS, Ng SSM, Ng GYF : A home-based program of transcutaneous electrical nerve stimulation and task-related trunk training improves trunk control in patients with stroke: a randomized controlled clinical trial. Neurorehabilitation and neural repair 2015;29(1):70-9 Pubmed Journal

125. Veerbeek JM, Van Wegen E., Van Peppen R., Van Der Wees PJ, Hendriks E., Rietberg M., et al. : What is the evidence for physical therapy poststroke? A systematic review and meta-analysis. PLoS ONE [Electronic Resource] 2014;9(2): Pubmed Journal

126. Sorinola IO, Powis I., White CM : Does additional exercise improve trunk function recovery in stroke patients? A meta-analysis. Neurorehabilitation 2014;35(2):205-213 Journal Website

127. Dae-Sik KO, Dae-In J, Sang-Yeol B : Effect of Lumbar Stabilization Exercises on the Balance Ability of Patients with Stroke: A Systematic Review. Journal of Physical Therapy Science 2014;26(12):1993-1996 4p Pubmed Journal

128. Kim Y, Chung Y, Hwang S : Weight-shift training improves trunk control, proprioception, and balance in patients with chronic hemiparetic stroke. The Tohoku journal of experimental medicine 2014;232(3):195-199 Journal Website

129. Cabanas-Valdes R., Cuchi GU, Bagur-Calafat C. : Trunk training exercises approaches for improving trunk performance and functional sitting balance in patients with stroke: A systematic review. Neurorehabilitation 2013;33(4):575-592 Pubmed Journal

130. Fujino Y, Amimoto K, Fukata K, Ishihara S, Makita S, Takahashi H : Does training sitting balance on a platform tilted 10° to the weak side improve trunk control in the acute phase after stroke? A randomized, controlled trial. Topics in stroke rehabilitation 2016;23(1):43-9 Pubmed Journal

131. Van Criekinge T, Truijen S, Schröder J, Maebe Z, Blanckaert K, van der Waal C, et al. : The effectiveness of trunk training on trunk control, sitting and standing balance and mobility post-stroke: a systematic review and meta-analysis. Clinical rehabilitation 2019;33(6):992-1002 Pubmed Journal

132. Souza DCB, de Sales Santos M, da Silva Ribeiro NM, Maldonado IL : Inpatient trunk exercises after recent stroke: An update meta-analysis of randomized controlled trials. NeuroRehabilitation 2019;44(3):369-377 Pubmed Journal

133. Yang X, Wang PU, Liu C, He C, Reinhardt JD : The effect of whole body vibration on balance, gait performance and mobility in people with stroke: a systematic review and meta-analysis. Clinical rehabilitation 2015;29(7):627-38 Pubmed Journal

134. Pollock A, Gray C, Culham E, Durward BR, Langhorne P : Interventions for improving sit-to-stand ability following stroke. Cochrane Database of Systematic Reviews 2014; Pubmed Journal

135. de Sousa DG, Harvey LA, Dorsch S, Varettas B, Jamieson S, Murphy A, et al. : Two weeks of intensive sit-to-stand training in addition to usual care improves sit-to-stand ability in people who are unable to stand up independently after stroke: a randomised trial. Journal of physiotherapy 2019;65(3):152-158 Pubmed Journal

136. Joey NCM, Ho Marc WK : Does self-initiated sit-to-stand training with an assistive device regain the independence of sit-to-stand in stroke patient? A single-blinded randomized controlled trial. Journal of rehabilitation and assistive technologies engineering 2020;7 1-8 Pubmed Journal

137. Liu M, Chen J, Fan W, Mu J, Zhang J, Wang LI, et al. : Effects of modified sit-to-stand training on balance control in hemiplegic stroke patients: a randomized controlled trial. Clinical rehabilitation 2016;30(7):627-36 Pubmed Journal

138. Kerr A, Clark A, Cooke EV, Rowe P, Pomeroy VM : Functional strength training and movement performance therapy produce analogous improvement in sit-to-stand early after stroke: early-phase randomised controlled trial. Physiotherapy 2017;103(3):259-265 Pubmed Journal

139. Yang DJ : Influence of biofeedback weight bearing training in sit to stand to sit and the limits of stability on stroke patients. Journal of physical therapy science 2016;28(11):3011-3014 Pubmed

140. Scrivener K, Dorsch S, McCluskey A, Schurr K, Graham PL, Cao Z, et al. : Bobath therapy is inferior to task-specific training and not superior to other interventions in improving lower limb activities after stroke: a systematic review. Journal of physiotherapy 2020;66(4):225-235 Pubmed Journal

141. Yang X, Wang PU, Liu C, He C, Reinhardt JD : The effect of whole body vibration on balance, gait performance and mobility in people with stroke: a systematic review and meta-analysis. Clinical Rehabilitation 2015;29(7):627-638 Pubmed Journal

142. Corbetta D, Imeri F, Gatti R : Rehabilitation that incorporates virtual reality is more effective than standard rehabilitation for improving walking speed, balance and mobility after stroke: a systematic review. J Physiother 2015;61 117-124 Pubmed Journal

143. Cheok G, Tan D, Low A, Hewitt J : Is Nintendo Wii an Effective Intervention for Individuals With Stroke? A Systematic Review and Meta-Analysis. Journal of the American Medical Directors Association 2015;16(11):923-932 Pubmed Journal

144. Stanton R., Ada L., Dean CM, Preston E. : Biofeedback improves activities of the lower limb after stroke: a systematic review. Journal of Physiotherapy 2011;57(3):145-155 Pubmed Journal

145. Veerbeek JM, Van Wegen E., Van Peppen R., Van Der Wees PJ, Hendriks E., Rietberg M., et al. : What is the evidence for physical therapy poststroke? A systematic review and meta-analysis. PLoS ONE 2014;9(2): Pubmed Journal

146. Cabanas-Valdes R., Cuchi GU, Bagur-Calafat C. : Trunk training exercises approaches for improving trunk performance and functional sitting balance in patients with stroke: A systematic review. Neurorehabilitation 2013;33(4):575-592 Journal Website

147. Miklitsch C, Krewer C, Freivogel S, Steube D : Effects of a predefined mini-trampoline training programme on balance, mobility and activities of daily living after stroke: a randomized controlled pilot study. Clinical rehabilitation 2013;27 939-947 Journal

148. Schmid AA, Van Puymbroeck M, Altenburger PA, Schalk NL, Dierks TA, Miller KK, et al. : Poststroke balance improves with yoga: a pilot study. STROKE 2012;43(9):2402-7 Journal Website

149. Wingham J, Adie K, Turner D, Schofield C, Pritchard C : Participant and caregiver experience of the Nintendo Wii Sports (TM) after stroke: qualitative study of the trial of Wii (TM) in stroke (TWIST). Clinical Rehabilitation 2015;29(3):295-305 Pubmed Journal

150. Paleg G, Livingstone R : Systematic review and clinical recommendations for dosage of supported home-based standing programs for adults with stroke, spinal cord injury and other neurological conditions. BMC Musculoskeletal Disorders 2015;16 1-16 16p Journal Website

151. Krpic A, Savanovic A, Cikajlo I : Telerehabilitation: remote multimedia-supported assistance and mobile monitoring of balance training outcomes can facilitate the clinical staff's effort. International Journal of Rehabilitation Research 2013;36(2):162-171 Journal

152. Youkhana S, Dean CM, Wolff M, Sherrington C, Tiedemann A : Yoga-based exercise improves balance and mobility in people aged 60 and over: a systematic review and meta-analysis. Age and ageing 2016;45(1):21-9 Pubmed Journal

153. van Duijnhoven HJR, Heeren A, Peters MAM, Veerbeek JM, Kwakkel G, Geurts ACH, et al. : Effects of Exercise Therapy on Balance Capacity in Chronic Stroke: Systematic Review and Meta-Analysis. Stroke; a journal of cerebral circulation 2016;47(10):2603-10 Pubmed Journal

154. Tang A, Tao A, Soh M, Tam C, Tan H, Thompson J, et al. : The effect of interventions on balance self-efficacy in the stroke population: a systematic review and meta-analysis. Clinical rehabilitation 2015;29(12):1168-77 Pubmed Journal

155. Stanton R, Ada L, Dean CM, Preston E : Biofeedback improves performance in lower limb activities more than usual therapy in people following stroke: a systematic review. Journal of physiotherapy 2017;63(1):11-16 Pubmed Journal

156. Hugues A, Di Marco J, Ribault S, Ardaillon H, Janiaud P, Xue Y, et al. : Limited evidence of physical therapy on balance after stroke:

A systematic review and meta-analysis. PloS one 2019;14(8):e0221700 Pubmed Journal

157. Mohammadi R, Semnani AV, Mirmohammadkhani M, Grampurohit N : Effects of Virtual Reality Compared to Conventional Therapy on Balance Poststroke: A Systematic Review and Meta-Analysis. Journal of stroke and cerebrovascular diseases 2019;28(7):1787-1798 Pubmed Journal

158. Zheng Q-X, Ge LI, Wang CC, Ma Q-S, Liao Y-T, Huang P-P, et al. : Robot-assisted therapy for balance function rehabilitation after stroke: A systematic review and meta-analysis. International journal of nursing studies 2019;95 7-18 Pubmed Journal

159. Iliescu AM, McIntyre A, Wiener J, Iruthayarajah J, Lee A, Caughlin S, et al. : Evaluating the effectiveness of aquatic therapy on mobility, balance, and level of functional independence in stroke rehabilitation: a systematic review and meta-analysis. Clinical rehabilitation 2020;34(1):56-68 Pubmed Journal

160. Wu S, Chen J, Wang S, Jiang M, Wang X, Wen Y : Effect of Tai Chi Exercise on Balance Function of Stroke Patients: A Meta-Analysis. Med Sci Monit Basic Res 2018;Dec(24):210-215 Pubmed Journal

161. Nascimento LR, Flores LC, de Menezes KKP, Teixeira-Salmela LF : Water-based exercises for improving walking speed, balance, and strength after stroke: a systematic review with meta-analyses of randomized trials. Physiotherapy 2020;107 100-110 Pubmed Journal

162. Chae CS, Jun JH, Im S, Jang Y, Park G-Y : Effectiveness of Hydrotherapy on Balance and Paretic Knee Strength in Patients With Stroke: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. American journal of physical medicine & rehabilitation 2020;99(5):409-419 Pubmed Journal

163. Nayak P, Mahmood A, Natarajan M, Hombali A, Prashanth CG, Solomon JM : Effect of aquatic therapy on balance and gait in stroke survivors: A systematic review and meta-analysis. Complementary therapies in clinical practice 2020;39 101110 Pubmed Journal

164. Díaz-Arribas MJ, Martín-Casas P, Cano-de-la-Cuerda R, Plaza-Manzano G : Effectiveness of the Bobath concept in the treatment of stroke: a systematic review. Disability and rehabilitation 2020;42(12):1636-1649 Pubmed Journal

165. Gamble K, Chiu A, Peiris C : Core Stability Exercises in Addition to Usual Care Physiotherapy Improve Stability and Balance After Stroke: A Systematic Review and Meta-analysis. Archives of physical medicine and rehabilitation 2020; Pubmed Journal

166. Prat-Luri A, Moreno-Navarro P, García JA, Barbado D, Vera-Garcia FJ, Elvira JLL : Do Initial Trunk Impairment, Age, Intervention Onset, and Training Volume Modulate the Effectiveness of Additional Trunk Exercise Programs after Stroke? A Systematic Review with Meta-Analyses. International journal of environmental research and public health 2020;17(23): Pubmed Journal

167. Veerbeek JM, van Wegen E, van Peppen R, van der Wees PJ, Hendriks E, Rietberg M, et al. : What is the evidence for physical therapy poststroke? A systematic review and meta-analysis. PloS one 2014;9(2):e87987 Pubmed Journal

168. Nadeau SE, Wu SS, Dobkin BH, Azen SP, Rose DK, Tilson JK, et al. : Effects of task-specific and impairment-based training compared with usual care on functional walking ability after inpatient stroke rehabilitation: LEAPS Trial. Neurorehabilitation and neural repair 2013;27(4):370-80 Pubmed Journal

169. Barclay RE, Stevenson TJ, Poluha W, Ripat J, Nett C, Srikesavan CS : Interventions for improving community ambulation in individuals with stroke. The Cochrane Database of Systematic Reviews 2015; Journal

170. van de Port IGL, Wevers LEG, Lindeman E, Kwakkel G : Effects of circuit training as alternative to usual physiotherapy after stroke: randomised controlled trial. BMJ (Clinical research ed.) 2012;344 e2672 Pubmed Journal

171. Merhrolz J, Pohl M, Elsner B : Treadmill training and body weight support for walking after stroke. The Cochrane Database of Systematic Reviews 2014; Journal

172. Polese JC, Ada L, Dean CM, Nascimento LR, Teixeira-Salmela LF : Treadmill training is effective for ambulatory adults with stroke: a systematic review. Journal of physiotherapy 2013;59(2):73-80 Pubmed Journal

173. Charalambous CC, Bonilha HS, Kautz SA, Gregory CM, Bowden MG : Rehabilitating walking speed poststroke with treadmill-based interventions: a systematic review of randomized controlled trials. Neurorehabilitation and neural repair 2013;27(8):709-21 Pubmed Journal

174. Ada L, Dean CM, Vargas J, Ennis S : Mechanically assisted walking with body weight support results in more independent walking than assisted overground walking in non-ambulatory patients early after stroke: a systematic review. Journal of physiotherapy 2010;56(3):153-61 Pubmed

175. Mehrholz J, Thomas S, Kugler J, Pohl M, Elsner B : Electromechanical-assisted training for walking after stroke. The Cochrane Database of Systematic Reviews 2020; Pubmed Journal

176. Nascimento LR, de Oliveira CQ, Ada L, Michaelsen SM, Teixeira-Salmela LF : Walking training with cueing of cadence improves walking speed and stride length after stroke more than walking training alone: a systematic review. Journal of physiotherapy 2015;61(1):10-5 Pubmed Journal

177. Howlett OA, Lannin NA, Ada L, McKinstry C : Functional electrical stimulation improves activity after stroke: a systematic review with meta-analysis. Archives of physical medicine and rehabilitation 2015;96(5):934-43 Pubmed Journal

178. Corbetta D, Imeri F, Gatti R : Rehabilitation that incorporates virtual reality is more effective than standard rehabilitation for improving walking speed, balance and mobility after stroke: a systematic review. Journal of physiotherapy 2015;61(3):117-24 Pubmed Journal

179. Rodrigues-Baroni JM, Nascimento LR, Ada L, Teixeira-Salmela LF : Walking training associated with virtual reality-based training increases walking speed of individuals with chronic stroke: systematic review with meta-analysis. Brazilian journal of physical therapy 18(6):502-12 Pubmed Journal

180. Braun S, Kleynen M, van Heel T, Kruithof N, Wade D, Beurskens A : The effects of mental practice in neurological rehabilitation; a systematic review and meta-analysis. Frontiers in human neuroscience 2013;7 390 Pubmed Journal

181. Tyson SF, Kent RM : Effects of an ankle-foot orthosis on balance and walking after stroke: a systematic review and pooled meta-analysis. Archives of physical medicine and rehabilitation 2013;94(7):1377-85 Pubmed Journal

182. Mehrholz J, Kugler J, Pohl M : Water-based exercises for improving activities of daily living after stroke. The Cochrane database of systematic reviews 2011;(1):CD008186 Pubmed Journal

183. Yang X, Wang PU, Liu C, He C, Reinhardt JD : The effect of whole body vibration on balance, gait performance and mobility in people with stroke: a systematic review and meta-analysis. Clinical rehabilitation 2015;29(7):627-38 Pubmed Journal

184. Kaur G, English C, Hillier S : How physically active are people with stroke in physiotherapy sessions aimed at improving motor function? A systematic review. Stroke research and treatment 2012;2012 820673 Pubmed Journal

185. Louie DR, Lim SB, Eng JJ : The Efficacy of Lower Extremity Mirror Therapy for Improving Balance, Gait, and Motor Function Poststroke: A Systematic Review and Meta-Analysis. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 2019;28(1):107-120 Pubmed Journal

186. Li YI, Wei Q, Gou W, He C : Effects of mirror therapy on walking ability, balance and lower limb motor recovery after stroke: a systematic review and meta-analysis of randomized controlled trials. Clinical rehabilitation 2018;32(8):1007-1021 Pubmed Journal

187. Plummer P, Iyigün G : Effects of Physical Exercise Interventions on Dual-Task Gait Speed Following Stroke: A Systematic Review and Meta-Analysis. Archives of physical medicine and rehabilitation 2018;99(12):2548-2560 Pubmed Journal

188. He Y, Yang L, Zhou J, Yao L, Pang MYC : Dual-task training effects on motor and cognitive functional abilities in individuals with stroke: a systematic review. Clinical rehabilitation 2018;32(7):865-877 Pubmed Journal

189. Silva S, Borges LR, Santiago L, Lucena L, Lindquist AR, Ribeiro T : Motor imagery for gait rehabilitation after stroke. The Cochrane database of systematic reviews 2020;9 CD013019 Pubmed Journal

190. Lo K, Stephenson M, Lockwood C : Effectiveness of robotic assisted rehabilitation for mobility and functional ability in adult stroke patients: a systematic review protocol. JBI database of systematic reviews and implementation reports 2017;15(1):39-48 Pubmed Journal

191. Bruni MF, Melegari C, De Cola MC, Bramanti A, Bramanti P, Calabrò RS : What does best evidence tell us about robotic gait rehabilitation in stroke patients: A systematic review and meta-analysis. Journal of clinical neuroscience : official journal of the Neurosurgical Society of Australasia 2018;48 11-17 Pubmed Journal

192. Shen C, Liu F, Yao L, Li Z, Qiu LI, Fang S : Effects of MOTOmed movement therapy on the mobility and activities of daily living of stroke patients with hemiplegia: a systematic review and meta-analysis. Clinical rehabilitation 2018;32(12):1569-1580 Pubmed Journal

193. Nascimento LR, da Silva LA, Araújo Barcellos JVM, Teixeira-Salmela LF : Ankle-foot orthoses and continuous functional electrical stimulation improve walking speed after stroke: a systematic review and meta-analyses of randomized controlled trials. Physiotherapy 2020;109 43-53 Journal Website

194. Tien H-H, Liu W-Y, Chen Y-L, Wu Y-C, Lien H-Y : Transcranial direct current stimulation for improving ambulation after stroke: a systematic review and meta-analysis. International journal of rehabilitation research. Internationale Zeitschrift fur Rehabilitationsforschung. Revue internationale de recherches de readaptation 2020;43(4):299-309 Pubmed Journal

195. Chen Z-H, Ye X-L, Chen W-J, Chen G-Q, Wu J-T, Wu H, et al. : Effectiveness of backward walking for people affected by stroke: A systematic review and meta-analysis of randomized controlled trials. Medicine 2020;99(27):e20731 Pubmed Journal

196. Ambrosini E, Parati M, Ferriero G, Pedrocchi A, Ferrante S : Does cycling induced by functional electrical stimulation enhance motor recovery in the subacute phase after stroke? A systematic review and meta-analysis. Clinical rehabilitation 2020;34(11):1341-1354 Pubmed Journal

197. Tung Y-C, Lai C-H, Liao C-D, Huang S-W, Liou T-H, Chen H-C : Repetitive transcranial magnetic stimulation of lower limb motor function in patients with stroke: a systematic review and meta-analysis of randomized controlled trials. Clinical rehabilitation 2019;33(7):1102-1112 Pubmed Journal

198. Shariat A, Najafabadi MG, Ansari NN, Cleland JA, Singh MAF, Memari A-H, et al. : The effects of cycling with and without functional electrical stimulation on lower limb dysfunction in patients post-stroke: A systematic review with meta-analysis. NeuroRehabilitation 2019;44(3):389-412 Pubmed Journal

199. Shahabi S, Shabaninejad H, Kamali M, Jalali M, Ahmadi Teymourlouy A : The effects of ankle-foot orthoses on walking speed in patients with stroke: a systematic review and meta-analysis of randomized controlled trials. Clinical rehabilitation 2020;34(2):145-159 Pubmed Journal

200. Peng T-H, Zhu J-D, Chen C-C, Tai R-Y, Lee C-Y, Hsieh Y-W : Action observation therapy for improving arm function, walking ability, and daily activity performance after stroke: a systematic review and meta-analysis. Clinical rehabilitation 2019;33(8):1277-1285 Pubmed Journal

201. Mendes LA, Lima IN, Souza T, do Nascimento GC, Resqueti VR, Fregonezi GA : Motor neuroprosthesis for promoting recovery of function after stroke. The Cochrane database of systematic reviews 2020;1 CD012991 Pubmed Journal

202. Jaqueline da Cunha M, Rech KD, Salazar AP, Pagnussat AS : Functional electrical stimulation of the peroneal nerve improves post-stroke gait speed when combined with physiotherapy. A systematic review and meta-analysis. Annals of physical and rehabilitation medicine 2021;64(1):101388 Pubmed Journal

203. Ghayour-Najafabadi M, Memari A-H, Hosseini L, Shariat A, Cleland JA : Repetitive Transcranial Magnetic Stimulation for the Treatment of Lower Limb Dysfunction in Patients Poststroke: A Systematic Review with Meta-Analysis. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 2019;28(12):104412 Pubmed Journal

204. Gibbons EM, Thomson AN, de Noronha M, Joseph S : Are virtual reality technologies effective in improving lower limb outcomes for patients following stroke - a systematic review with meta-analysis. Topics in stroke rehabilitation 2016;23(6):440-457 Pubmed

205. de Rooij IJM, van de Port IGL, Meijer J-WG : Effect of Virtual Reality Training on Balance and Gait Ability in Patients With Stroke:

Systematic Review and Meta-Analysis. Physical therapy 2016;96(12):1905-1918 Pubmed

206. Ferreira V, Carvas N, Artilheiro MC, Pompeu JE, Hassan SA, Kasawara KT : Interactive Video Gaming Improves Functional Balance in Poststroke Individuals: Meta-Analysis of Randomized Controlled Trials. Evaluation & the health professions 2020;43(1):23-32 Pubmed Journal

207. Lin S, Sun QI, Wang H, Xie G : Influence of transcutaneous electrical nerve stimulation on spasticity, balance, and walking speed in stroke patients: A systematic review and meta-analysis. Journal of rehabilitation medicine 2018;50(1):3-7 Pubmed Journal

208. Kwong PW, Ng GY, Chung RC, Ng SS : Transcutaneous electrical nerve stimulation improves walking capacity and reduces spasticity in stroke survivors: a systematic review and meta-analysis. Clinical rehabilitation 2018;32(9):1203-1219 Pubmed Journal

209. Li R-Q, Li Z-M, Tan J-Y, Chen G-L, Lin W-Y : Effects of motor imagery on walking function and balance in patients after stroke: A quantitative synthesis of randomized controlled trials. Complementary therapies in clinical practice 2017;28 75-84 Pubmed Journal

210. Broderick P, Horgan F, Blake C, Ehrensberger M, Simpson D, Monaghan K : Mirror therapy for improving lower limb motor function and mobility after stroke: A systematic review and meta-analysis. Gait & posture 2018;63 208-220 Pubmed Journal

211. Schröder J, Truijen S, Van Criekinge T, Saeys W : Peripheral somatosensory stimulation and postural recovery after stroke - a systematic review. Topics in stroke rehabilitation 2018;25(4):312-320 Pubmed Journal

212. Hong Z, Sui M, Zhuang Z, Liu H, Zheng X, Cai C, et al. : Effectiveness of Neuromuscular Electrical Stimulation on Lower Limbs of Patients With Hemiplegia After Chronic Stroke: A Systematic Review. Archives of Physical Medicine and Rehabilitation 2018;99(5):1011-1022.e1 Journal Website

213. Coupar F, Pollock A, van Wijck F, Morris J, Langhorne P : Simultaneous bilateral training for improving arm function after stroke. The Cochrane database of systematic reviews 2010;(4):CD006432 Pubmed Journal

214. Coupar F, Pollock A, van Wijck F, Morris J, Langhorne P : Simultaneous bilateral training for improving arm function after stroke. Cochrane Database of Systematic Reviews 2010; Pubmed Journal

215. Elsner B, Kugler J, Pohl M, Mehrholz J : Transcranial direct current stimulation (tDCS) for improving activities of daily living, and physical and cognitive functioning, in people after stroke. Cochrane Database of Systematic Reviews 2020;11 Pubmed Journal

216. Veerbeek JM, van Wegen E, van Peppen R, van der Wees PJ, Hendriks E, Rietberg M, et al. : What is the evidence for physical therapy poststroke? A systematic review and meta-analysis. PloS one 2014;9(2):e87987 Pubmed Journal

217. Tedesco Triccas L, Burridge JH, Hughes AM, Pickering RM, Desikan M, Rothwell JC, et al. : Multiple sessions of transcranial direct current stimulation and upper extremity rehabilitation in stroke: A review and meta-analysis. Clinical neurophysiology : official journal of the International Federation of Clinical Neurophysiology 2016;127(1):946-55 Pubmed Journal

218. Marquez J, van Vliet P, McElduff P, Lagopoulos J, Parsons M : Transcranial direct current stimulation (tDCS): does it have merit in stroke rehabilitation? A systematic review. International journal of stroke : official journal of the International Stroke Society 2015;10(3):306-16 Pubmed Journal

219. Hao Z, Wang D, Zeng Y, Liu M : Repetitive transcranial magnetic stimulation for improving function after stroke. Cochrane Database of Systematic Reviews 2013; Pubmed Journal

220. Le QU, Qu Y, Tao Y, Zhu S : Effects of repetitive transcranial magnetic stimulation on hand function recovery and excitability of the motor cortex after stroke: a meta-analysis. American journal of physical medicine & rehabilitation / Association of Academic Physiatrists 2014;93(5):422-30 Pubmed Journal

221. Winter J, Hunter S, Sim J, Crome P : Hands-on therapy interventions for upper limb motor dysfunction following stroke. The Cochrane database of systematic reviews 2011;(6):CD006609 Pubmed Journal

222. Smedes F, van der Salm A, Koel G, Oosterveld F : Manual mobilization of the wrist: a pilot study in rehabilitation of patients with a chronic hemiplegic hand post-stroke. Journal of hand therapy : official journal of the American Society of Hand Therapists 27(3):209-15; quiz 216 Pubmed Journal

223. Mehrholz J, Pohl M, Platz T, Kugler J, Elsner B : Electromechanical and robot-assisted arm training for improving activities of daily living, arm function, and arm muscle strength after stroke. Cochrane Database of Systematic Reviews 2018; Pubmed Journal

224. Kho AY, Liu KPY, Chung RCK : Meta-analysis on the effect of mental imagery on motor recovery of the hemiplegic upper extremity function. Australian occupational therapy journal 2014;61(2):38-48 Pubmed Journal

225. Barclay RE, Stevenson TJ, Poluha W, Semenko B, Schubert J : Mental practice for treating upper extremity deficits in individuals with hemiparesis after stroke. The Cochrane database of systematic reviews 2020;(5):CD005950 Pubmed Journal

226. Braun S, Kleynen M, van Heel T, Kruithof N, Wade D, Beurskens A : The effects of mental practice in neurological rehabilitation; a systematic review and meta-analysis. Frontiers in human neuroscience 2013;7 390 Pubmed Journal

227. Thieme H, Morkisch N, Mehrholz J, Pohl M, Behrens J, Borgetto B, et al. : Mirror therapy for improving motor function after stroke. Cochrane Database Syst Rev . 2018;7(7):CD008449 Pubmed Journal

228. Tyson SF, Kent RM : The effect of upper limb orthotics after stroke: a systematic review. NeuroRehabilitation 2011;28(1):29-36 Pubmed Journal

229. Wee SK, Hughes A-M, Warner M, Burridge JH : Trunk restraint to promote upper extremity recovery in stroke patients: a systematic review and meta-analysis. Neurorehabilitation and neural repair 2014;28(7):660-77 Pubmed Journal

230. Laver K, Lange B, George S, Deutsch J, Saposnik G, Crotty M : Virtual reality for stroke rehabilitation. Cochrane Database of Systematic Reviews 2017; Pubmed Journal

231. Lohse KR, Hilderman CGE, Cheung KL, Tatla S, Van der Loos HFM : Virtual reality therapy for adults post-stroke: a systematic review and meta-analysis exploring virtual environments and commercial games in therapy. PloS one 2014;9(3):e93318 Pubmed Journal

232. French B, Thomas LH, Coupe J, McMahon NE : Repetitive task training for improving functional ability after stroke. Cochrane Database Syst Rev 2016; Pubmed Journal

233. Vafadar AK, Côté JN, Archambault PS : Effectiveness of functional electrical stimulation in improving clinical outcomes in the upper arm following stroke: a systematic review and meta-analysis. BioMed research international 2015;2015 729768 Pubmed Journal

234. Stevenson T, Thalman L, Christie H, Poluha W : Constraint-Induced Movement Therapy Compared to Dose-Matched Interventions for Upper-Limb Dysfunction in Adult Survivors of Stroke: A Systematic Review with Meta-analysis. Physiotherapy Canada. Physiothérapie Canada 2012;64(4):397-413 Pubmed Journal

235. Thrane G, Friborg O, Anke A, Indredavik B : A meta-analysis of constraint-induced movement therapy after stroke. Journal of rehabilitation medicine 2014;46(9):833-42 Pubmed Journal

236. Corbetta D, Sirtori V, Castellini G, Moja L, Gatti R : Constraint-induced movement therapy for upper extremities in people with stroke. Cochrane Database of Systematic Reviews 2015 2015; Pubmed Journal

237. Subramanian SK, Massie CL, Malcolm MP, Levin MF : Does provision of extrinsic feedback result in improved motor learning in the upper limb poststroke? A systematic review of the evidence. Neurorehabilitation and neural repair 2010;24(2):113-24 Pubmed Journal

238. van Delden AEQ, Peper CE, Beek PJ, Kwakkel G : Unilateral versus bilateral upper limb exercise therapy after stroke: a systematic review. Journal of rehabilitation medicine 2012;44(2):106-17 Pubmed Journal

239. Parker J, Mountain G, Hammerton J : A review of the evidence underpinning the use of visual and auditory feedback for computer technology in post-stroke upper-limb rehabilitation. Disability and rehabilitation. Assistive technology 2011;6(6):465-72 Pubmed

Journal

240. Kwakkel G, Veerbeek JM, van Wegen EEH, Wolf SL : Constraint-induced movement therapy after stroke. The Lancet. Neurology 2015;14(2):224-34 Pubmed Journal

241. Lo K, Stephenson M, Lockwood C : The economic cost of robotic rehabilitation for adult stroke patients: a systematic review. JBI database of systematic reviews and implementation reports 2019;17(4):520-547 Pubmed Journal

242. Song K, Wang L, Wu W : Mental practice for upper limb motor restoration after stroke: an updated meta-analysis of randomized controlled trials. Topics in stroke rehabilitation 2019;26(2):87-93 Pubmed Journal

243. Borges LR, Fernandes AB, Melo LP, Guerra RO, Campos TF : Action observation for upper limb rehabilitation after stroke. The Cochrane database of systematic reviews 2018;10 CD011887 Pubmed Journal

244. Guerra ZF, Lucchetti ALG, Lucchetti G : Motor Imagery Training After Stroke: A Systematic Review and Meta-analysis of Randomized Controlled Trials. Journal of neurologic physical therapy 2017;41(4):205-214 Pubmed Journal

245. Zhang Q, Fu C, Liang Z, Peng L, Xiong F, Chen LI, et al. : The effect of adding trunk restraint to task-oriented training in improving function in stroke patients: A systematic review and meta-analysis. NeuroRehabilitation 2020;46(1):95-108 Pubmed Journal

246. da Silva ESM, Ocamoto GN, Santos-Maia GLD, de Fátima Carreira Moreira Padovez R, Trevisan C, de Noronha MA, et al. : The Effect of Priming on Outcomes of Task-Oriented Training for the Upper Extremity in Chronic Stroke: A Systematic Review and Meta-analysis. Neurorehabilitation and neural repair 2020;34(6):479-504 Pubmed Journal

247. Morkisch N, Thieme H, Dohle C : How to perform mirror therapy after stroke? Evidence from a meta-analysis. Restorative neurology and neuroscience 2019;37(5):421-435 Pubmed Journal

248. van Lieshout ECC, van der Worp HB, Visser-Meily JMA, Dijkhuizen RM : Timing of Repetitive Transcranial Magnetic Stimulation Onset for Upper Limb Function After Stroke: A Systematic Review and Meta-Analysis. Frontiers in neurology 2019;10 1269 Pubmed Journal

249. Xiang H, Sun J, Tang X, Zeng K, Wu X : The effect and optimal parameters of repetitive transcranial magnetic stimulation on motor recovery in stroke patients: a systematic review and meta-analysis of randomized controlled trials. Clinical rehabilitation 2019;33(5):847-864 Pubmed Journal

250. O'Brien AT, Bertolucci F, Torrealba-Acosta G, Huerta R, Fregni F, Thibaut A : Non-invasive brain stimulation for fine motor improvement after stroke: a meta-analysis. European journal of neurology 2018;25(8):1017-1026 Pubmed Journal

251. Zhang L, Xing G, Shuai S, Guo Z, Chen H, McClure MA, et al. : Low-Frequency Repetitive Transcranial Magnetic Stimulation for Stroke-Induced Upper Limb Motor Deficit: A Meta-Analysis. Neural plasticity 2017;2017 2758097 Pubmed Journal

252. Liu X-H, Huai J, Gao J, Zhang Y, Yue S-W : Constraint-induced movement therapy in treatment of acute and sub-acute stroke: a meta-analysis of 16 randomized controlled trials. Neural regeneration research 2017;12(9):1443-1450 Pubmed Journal

253. Chen P-M, Kwong PWH, Lai CKY, Ng SSM : Comparison of bilateral and unilateral upper limb training in people with stroke: A systematic review and meta-analysis. PloS one 2019;14(5):e0216357 Pubmed Journal

254. Repetitive peripheral magnetic stimulation for impairment and disability in people after stroke [Data only. When citing this record quote "Cochrane Database of Systematic Reviews 2019, Issue 11".].

255. Monte-Silva K, Piscitelli D, Norouzi-Gheidari N, Batalla MAP, Archambault P, Levin MF : Electromyogram-Related Neuromuscular Electrical Stimulation for Restoring Wrist and Hand Movement in Poststroke Hemiplegia: A Systematic Review and Meta-Analysis. Neurorehabilitation and neural repair 2019;33(2):96-111 Pubmed Journal

256. Veerbeek JM, Langbroek-Amersfoort AC, van Wegen EEH, Meskers CGM, Kwakkel G : Effects of Robot-Assisted Therapy for the

Upper Limb After Stroke. Neurorehabilitation and neural repair 2017;31(2):107-121 Pubmed Journal

257. Chien W-T, Chong Y-Y, Tse M-K, Chien C-W, Cheng H-Y : Robot-assisted therapy for upper-limb rehabilitation in subacute stroke patients: A systematic review and meta-analysis. Brain and behavior 2020;10(8):e01742 Pubmed Journal

258. Chen Z, Wang C, Fan W, Gu M, Yasin G, Xiao S, et al. : Robot-Assisted Arm Training versus Therapist-Mediated Training after Stroke: A Systematic Review and Meta-Analysis. Journal of healthcare engineering 2020; 8810867 Pubmed Journal

259. Saavedra-García A, Moral-Munoz JA, Lucena-Anton D : Mirror therapy simultaneously combined with electrical stimulation for upper limb motor function recovery after stroke: a systematic review and meta-analysis of randomized controlled trials. Clinical rehabilitation 2021;35(1):39-50 Pubmed Journal

260. Stockley RC, Jarvis K, Boland P, Clegg AJ : Systematic Review and Meta-Analysis of the Effectiveness of Mental Practice for the Upper Limb After Stroke: Imagined or Real Benefit?. Archives of physical medicine and rehabilitation 2020; Pubmed Journal

261. Karamians R, Proffitt R, Kline D, Gauthier LV : Effectiveness of Virtual Reality- and Gaming-Based Interventions for Upper Extremity Rehabilitation Poststroke: A Meta-analysis. Archives of physical medicine and rehabilitation 2020;101(5):885-896 Pubmed Journal

262. Aminov A, Rogers JM, Middleton S, Caeyenberghs K, Wilson PH : What do randomized controlled trials say about virtual rehabilitation in stroke? A systematic literature review and meta-analysis of upper-limb and cognitive outcomes. Journal of neuroengineering and rehabilitation 2018;15(1):29 Pubmed Journal

263. Etoom M, Hawamdeh M, Hawamdeh Z, Alwardat M, Giordani L, Bacciu S, et al. : Constraint-induced movement therapy as a rehabilitation intervention for upper extremity in stroke patients: systematic review and meta-analysis. International journal of rehabilitation research 2016;39(3):197-210 Pubmed Journal

264. Maier M, Rubio Ballester B, Duff A, Duarte Oller E, Verschure PFMJ : Effect of Specific Over Nonspecific VR-Based Rehabilitation on Poststroke Motor Recovery: A Systematic Meta-analysis. Neurorehabilitation and neural repair 2019;33(2):112-129 Pubmed Journal

265. Rodgers H, Bosomworth H, Krebs HI, van Wijck F, Howel D, Wilson N, et al. : Robot assisted training for the upper limb after stroke (RATULS): a multicentre randomised controlled trial. Lancet (London, England) 2019;394(10192):51-62 Pubmed Journal

266. Yang J-D, Liao C-D, Huang S-W, Tam K-W, Liou T-H, Lee Y-H, et al. : Effectiveness of electrical stimulation therapy in improving arm function after stroke: a systematic review and a meta-analysis of randomised controlled trials. Clinical rehabilitation 2019;33(8):1286-1297 Pubmed Journal

267. Eraifej J, Clark W, France B, Desando S, Moore D : Effectiveness of upper limb functional electrical stimulation after stroke for the improvement of activities of daily living and motor function: a systematic review and meta-analysis. Systematic reviews 2017;6(1):40 Pubmed Journal

268. Sackley CM, Walker MF, Burton CR, Watkins CL, Mant J., Roalfe AK, et al. : An occupational therapy intervention for residents with stroke related disabilities in UK care homes (OTCH): cluster randomised controlled trial. BMJ (Clinical research ed.) 2015;350 h468 Pubmed Journal

269. Legg LA, Lewis SR, Schofield-Robinson OJ, Drummond AE, Langhorne P : Occupational therapy for adults with problems in activities of daily living after stroke. The Cochrane database of systematic reviews 2017;(4):CD003585 Pubmed Journal

270. Tomori K., Nagayama H., Ohno K., Nagatani R., Saito Y., Takahashi K., et al. : Comparison of occupation-based and impairment-based occupational therapy for subacute stroke: a randomized controlled feasibility study. Clinical rehabilitation 2015;29(8):752-62 Pubmed Journal

271. Guidetti S, Ranner M, Tham K, Andersson M, Ytterberg C, von Koch L : A "client-centred activities of daily living" intervention for persons with stroke: One-year follow-up of a randomized controlled trial. Journal of rehabilitation medicine 2015;47(7):605-11 Pubmed Journal

272. Bertilsson AS, Ranner M., von Koch L., Eriksson G., Johansson U., Ytterberg C., et al. : A client-centred ADL intervention: three-month follow-up of a randomized controlled trial. Scandinavian journal of occupational therapy 2014;21(5):377-91 Journal Website

273. Walker MF, Sunderland A., Fletcher-Smith J., Drummond A., Logan P., Edmans JA, et al. : The DRESS trial: a feasibility randomized controlled trial of a neuropsychological approach to dressing therapy for stroke inpatients. Clinical Rehabilitation 2012;26(8):675-685 Journal Website

274. Hoffmann T, Bennett S, Koh C-L, McKenna Kryss T. : Occupational therapy for cognitive impairment in stroke patients. Cochrane Database of Systematic Reviews 2010;(9): Journal Website

275. Polatajko HJ, McEwen SE, Ryan JD, Baum CM : Pilot randomized controlled trial investigating cognitive strategy use to improve goal performance after stroke. Am J Occup Ther 2012;66(1):104-9 Journal Website

276. Skidmore ER, Dawson DR, Butters MA, Grattan ES, Juengst SB, Whyte EM, et al. : Strategy Training Shows Promise for Addressing Disability in the First 6 Months After Stroke. Neurorehabilitation and neural repair 2015;29(P30 MH090333 (NIH)):668-676 Journal Website

277. Elsner B, Kugler J, Pohl M, Mehrholz J : Transcranial direct current stimulation (tDCS) for improving activities of daily living, and physical and cognitive functioning, in people after stroke. Cochrane Database of Systematic Reviews 2016;(3): Journal Website

278. Kong JC, Lee MS, Shin BC, Song YS, Ernst E. : Acupuncture for functional recovery after stroke: a systematic review of sham-controlled randomized clinical trials. CMAJ Canadian Medical Association Journal 2010;182(16):1723-9 Journal Website

279. Bai YL, Li L., Hu YS, Wu Y., Xie PJ, Wang SW, et al. : Prospective, randomized controlled trial of physiotherapy and acupuncture on motor function and daily activities in patients with ischemic stroke. Journal of Alternative and Complementary Medicine 2013;19(8):684-689 Journal Website

280. Mehrholz J, Kugler J, Pohl M : Water-based exercises for improving activities of daily living after stroke. Cochrane Database of Systematic Reviews 2011;(1): Journal Website

281. Martinsson L, Hårdemark H, Eksborg S : Amphetamines for improving recovery after stroke. The Cochrane database of systematic reviews 2007;(1):CD002090 Pubmed Journal

282. Lokk J., Roghani RS, Delbari A. : Effect of methylphenidate and/or levodopa coupled with physiotherapy on functional and motor recovery after stroke - a randomized, double-blind, placebo-controlled trial. Acta Neurologica Scandinavica 2011;123(4):266-273 Journal Website

283. Laver KE, Lange B, George S, Deutsch JE, Saposnik G, Crotty M : Virtual reality for stroke rehabilitation. Cochrane Database of Systematic Reviews 2017; Pubmed Journal Website

284. Cheng D, Qu Z, Huang J, Xiao Y, Luo H, Wang J : Motivational interviewing for improving recovery after stroke. Cochrane Database of Systematic Reviews 2015;(6): Journal Website

285. Braun SM, Beurskens AJ, Kleynen M, Oudelaar B, Schols JM, Wade DT : A multicenter randomized controlled trial to compare subacute 'treatment as usual' with and without mental practice among persons with stroke in Dutch nursing homes. Journal of the American Medical Directors Association 2012;13(1):85.e1-7 Journal Website

286. McEwen S, Polatajko H, Baum C, Rios J, Cirone D, Doherty M, et al. : Combined Cognitive-Strategy and Task-Specific Training Improve Transfer to Untrained Activities in Subacute Stroke: An Exploratory Randomized Controlled Trial. Neurorehabilitation and neural repair 2015;29(6):526-36 Pubmed Journal

287. Walker MF, Leonardi-Bee J, Bath P, Langhorne P, Dewey M, Corr S, et al. : Individual patient data meta-analysis of randomized controlled trials of community occupational therapy for stroke patients. Stroke; a journal of cerebral circulation 2004;35(9):2226-32 Pubmed

288. Legg L, Tilney R, Hsieh C-F, Wu S, Lundstrom E, Rudberg A-S, et al. : Selective serotonin reuptake inhibitors (SSRIs) for stroke

recovery. The Cochrane database of systematic reviews 2019;11 CD009286 Pubmed Journal

289. Hedman A, Eriksson G, von Koch L, Guidetti S : Five-year follow-up of a cluster-randomized controlled trial of a client-centred activities of daily living intervention for people with stroke. Clinical rehabilitation 2019;33(2):262-276 Pubmed Journal

290. EFFECTS Trial Collaboration : Safety and efficacy of fluoxetine on functional recovery after acute stroke (EFFECTS): a randomised, double-blind, placebo-controlled trial. The Lancet. Neurology 2020;19(8):661-669 Pubmed Journal

291. AFFINITY Trial Collaboration : Safety and efficacy of fluoxetine on functional outcome after acute stroke (AFFINITY): a randomised, double-blind, placebo-controlled trial. The Lancet. Neurology 2020;19(8):651-660 Pubmed Journal

292. Sakai K, Yasufuku Y, Kamo T, Ota E, Momosaki R : Repetitive peripheral magnetic stimulation for impairment and disability in people after stroke. The Cochrane database of systematic reviews 2019;11 CD011968 Pubmed Journal

293. Elsner B, Kwakkel G, Kugler J, Mehrholz J : Transcranial direct current stimulation (tDCS) for improving capacity in activities and arm function after stroke: a network meta-analysis of randomised controlled trials. Journal of Neuroengineering and Rehabilitation 2017;14(1):95 Pubmed Journal

294. Yang AI, Wu HM, Tang J-L, Xu LI, Yang M, Liu GJ : Acupuncture for stroke rehabilitation. The Cochrane database of systematic reviews 2016;(8):CD004131 Pubmed Journal

295. Zou L, Yeung A, Zeng N, Wang C, Sun LI, Thomas GA, et al. : Effects of Mind-Body Exercises for Mood and Functional Capabilities in Patients with Stroke: An Analytical Review of Randomized Controlled Trials. International journal of environmental research and public health 2018;15(4): Pubmed Journal

296. Turgut N, Möller L, Dengler K, Steinberg K, Sprenger A, Eling P, et al. : Adaptive Cueing Treatment of Neglect in Stroke Patients Leads to Improvements in Activities of Daily Living: A Randomized Controlled, Crossover Trial. Neurorehabilitation and neural repair 2018;32(11):988-998 Pubmed Journal

297. Han D-S, Chuang P-W, Chiu E-C : Effect of home-based reablement program on improving activities of daily living for patients with stroke: A pilot study. Medicine 2020;99(49):e23512 Pubmed Journal

298. Wang J, Tian L, Zhang Z, Yuan BO, Zhang T, Li X, et al. : Scalp-acupuncture for patients with hemiplegic paralysis of acute ischaemic stroke: a randomized controlled clinical trial. Journal of traditional Chinese medicine = Chung i tsa chih ying wen pan 2020;40(5):845-854 Pubmed Journal

299. Brady MC, Kelly H, Godwin J, Enderby P, Campbell P : Speech and language therapy for aphasia following stroke. Cochrane Database of Systematic Reviews 2016; Pubmed Journal

300. Ren C-L, Zhang G-F, Xia N, Jin C-H, Zhang X-H, Hao J-F, et al. : Effect of low-frequency rTMS on aphasia in stroke patients: a meta-analysis of randomized controlled trials. PloS one 2014;9(7):e102557 Pubmed Journal

301. Elsner B, Kugler J, Pohl M, Mehrholz J : Transcranial direct current stimulation (tDCS) for improving aphasia in patients with aphasia after stroke. Cochrane Database of Systematic Reviews 2019; Pubmed Journal

302. Bowen A, Hesketh A, Patchick E, Young A, Davies L, Vail A, et al. : Clinical effectiveness, cost-effectiveness and service users' perceptions of early, well-resourced communication therapy following a stroke: a randomised controlled trial (the ACT NoW Study). Health technology assessment (Winchester, England) 2012;16(26):1-160 Pubmed Journal

303. Greener J, Enderby P, Whurr R : Pharmacological treatment for aphasia following stroke. The Cochrane database of systematic reviews 2001;(4):CD000424 Pubmed Journal

304. Barbancho MA, Berthier ML, Navas-Sánchez P, Dávila G, Green-Heredia C, García-Alberca JM, et al. : Bilateral brain reorganization with memantine and constraint-induced aphasia therapy in chronic post-stroke aphasia: An ERP study. Brain and language 2015;145-146 1-10 Pubmed Journal

305. Yan Y, Wang M, Zhang L, Qiu Z, Jiang W, Xu M, et al. : Nao-Xue-Shu Oral Liquid Improves Aphasia of Mixed Stroke. Evidence-based complementary and alternative medicine : eCAM 2015;2015 709568 Pubmed Journal

306. Breitenstein C, Korsukewitz C, Baumgärtner A, Flöel A, Zwitserlood P, Dobel C, et al. : L-dopa does not add to the success of high-intensity language training in aphasia. Restorative neurology and neuroscience 2015;33(2):115-20 Pubmed Journal

307. Hong JM, Shin DH, Lim TS, Lee JS, Huh K : Galantamine administration in chronic post-stroke aphasia. Journal of neurology, neurosurgery, and psychiatry 2012;83(7):675-80 Pubmed Journal

308. Güngör L, Terzi M, Onar MK : Does long term use of piracetam improve speech disturbances due to ischemic cerebrovascular diseases?. Brain and language 2011;117(1):23-7 Pubmed Journal

309. Jianu DC, Muresanu DF, Bajenaru O, Popescu BO, Deme SM, Moessler H, et al. : Cerebrolysin adjuvant treatment in Broca's aphasics following first acute ischemic stroke of the left middle cerebral artery. Journal of medicine and life 2010;3(3):297-307 Pubmed

310. Humphreys I, Thomas S, Phillips C, Lincoln N : Cost analysis of the Communication and Low Mood (CALM) randomised trial of behavioural therapy for stroke patients with aphasia. Clinical rehabilitation 2015;29(1):30-41 Pubmed Journal

311. Latimer NR, Dixon S, Palmer R : Cost-utility of self-managed computer therapy for people with aphasia. International journal of technology assessment in health care 2013;29(4):402-9 Pubmed Journal

312. Kampfe CM : Reading comprehension of deaf adolescent residential school students and its relationship to hearing mothers' communication strategies and skills. American annals of the deaf 1989;134(5):317-22 Pubmed

313. Ballard KJ, Wambaugh JL, Duffy JR, Layfield C, Maas E, Mauszycki S, et al. : Treatment for Acquired Apraxia of Speech: A Systematic Review of Intervention Research Between 2004 and 2012. American journal of speech-language pathology / American Speech-Language-Hearing Association 2015;24(2):316-337 Pubmed Journal

314. Wambaugh J, Duffy J, McNeil M, Robin D, Rogers M : Treatment guidelines for acquired apraxia of speech: A synthesis and evaluation of the evidence. Journal of medical speech-language pathology 2006;

315. Varley R, Cowell PE, Dyson L, Inglis L, Roper A, Whiteside SP : Self-Administered Computer Therapy for Apraxia of Speech: Two-Period Randomized Control Trial With Crossover. Stroke 2016;47(3):822-8 Pubmed Journal

316. Wang J, Wu D, Cheng Y, Song W, Yuan Y, Zhang XU, et al. : Effects of Transcranial Direct Current Stimulation on Apraxia of Speech and Cortical Activation in Patients With Stroke: A Randomized Sham-Controlled Study. American journal of speech-language pathology 2019;28(4):1625-1637 Pubmed Journal

317. Mackenzie C, Muir M, Allen C, Jensen A : Non-speech oro-motor exercises in post-stroke dysarthria intervention: a randomized feasibility trial. International journal of language & communication disorders / Royal College of Speech & Language Therapists 49(5):602-17 Pubmed Journal

318. Bowen A, Hesketh A, Patchick E, Young A, Davies L, Vail A, et al. : Clinical effectiveness, cost-effectiveness and service users' perceptions of early, well-resourced communication therapy following a stroke: a randomised controlled trial (the ACT NoW Study). Health technology assessment (Winchester, England) 2012;16(26):1-160 Pubmed Journal

319. Chiaramonte R, Pavone P, Vecchio M : Speech rehabilitation in dysarthria after stroke: a systematic review of the studies. European journal of physical and rehabilitation medicine 2020;56(5):547-562 Pubmed Journal

320. Lehman Blake M, Frymark T, Venedictov R : An evidence-based systematic review on communication treatments for individuals with right hemisphere brain damage. American journal of speech-language pathology / American Speech-Language-Hearing Association 2013;22(1):146-60 Pubmed Journal

321. Ferré P, Ska B, Lajoie C, Bleau A, Joanette Y : Clinical Focus on Prosodic, Discursive and Pragmatic Treatment for Right Hemisphere Damaged Adults: What's Right?. Rehabilitation research and practice 2011;2011 131820 Pubmed Journal

322. Rosenbek JC, Rodriguez AD, Hieber B, Leon SA, Crucian GP, Ketterson TU, et al. : Effects of two treatments for aprosodia secondary to acquired brain injury. Journal of rehabilitation research and development 43(3):379-90 Pubmed

323. Lundgren K, Brownell H, Cayer-Meade C, Milione J, Kearns K : Treating Metaphor Interpretation Deficits Subsequent to Right Hemisphere Brain Damage: Preliminary Results. Aphasiology 2011;25(4):456-474 Pubmed

324. Bowen A, Knapp P, Gillespie D, Nicolson DJ, Vail A : Non-pharmacological interventions for perceptual disorders following stroke and other adult-acquired, non-progressive brain injury. Cochrane Database of Systematic Reviews 2011; Pubmed Journal

325. Virk S, Williams T, Brunsdon R, Suh F, Morrow A : Cognitive remediation of attention deficits following acquired brain injury: A systematic review and meta-analysis. NeuroRehabilitation 2015;36(3):367-77 Pubmed Journal

326. Liu-Ambrose T, Eng JJ : Exercise training and recreational activities to promote executive functions in chronic stroke: a proof-of-concept study. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 2015;24(1):130-7 Pubmed Journal

327. Ihle-Hansen H, Thommessen B, Fagerland MW, Øksengård AR, Wyller TB, Engedal K, et al. : Multifactorial vascular risk factor intervention to prevent cognitive impairment after stroke and TIA: a 12-month randomized controlled trial. International journal of stroke : official journal of the International Stroke Society 2014;9(7):932-8 Pubmed Journal

328. Gamito P, Oliveira J, Santos N, Pacheco J, Morais D, Saraiva T, et al. : Virtual exercises to promote cognitive recovery in stroke patients: The comparison between head mounted displays versus screen exposure methods. International Journal on Disability and Human Development 2014;13(3):337-342 Journal

329. Loetscher T, Potter K-J, Wong D, das Nair R : Cognitive rehabilitation for attention deficits following stroke. The Cochrane database of systematic reviews 2019;2019(11): Pubmed Journal

330. Rogers JM, Foord R, Stolwyk RJ, Wong D, Wilson PH : General and Domain-Specific Effectiveness of Cognitive Remediation after Stroke: Systematic Literature Review and Meta-Analysis. Neuropsychology review 2018;28(3):285-309 Pubmed Journal

331. Yan R-B, Zhang X-L, Li Y-H, Hou J-M, Chen H, Liu H-L : Effect of transcranial direct-current stimulation on cognitive function in stroke patients: A systematic review and meta-analysis. PloS one 2020;15(6):e0233903 Pubmed Journal

332. Liu Y, Yin M, Luo J, Huang LI, Zhang S, Pan C, et al. : Effects of transcranial magnetic stimulation on the performance of the activities of daily living and attention function after stroke: a randomized controlled trial. Clinical rehabilitation 2020; 269215520946386 Pubmed Journal

333. Moumdjian L, Sarkamo T, Leone C, Leman M, Feys P : Effectiveness of music-based interventions on motricity or cognitive functioning in neurological populations: a systematic review. European journal of physical and rehabilitation medicine 2017;53(3):466-482 Pubmed Journal

334. Wiley E, Khattab S, Tang A : Examining the effect of virtual reality therapy on cognition post-stroke: a systematic review and meta-analysis. Disability and rehabilitation. Assistive technology 2020; 1-11 Pubmed Journal

335. Magee W, Clark I, Tamplin J, Bradt J : Music interventions for acquired brain injury. The Cochrane database of systematic reviews 2017; Pubmed

336. Tsai P-Y, Lin W-S, Tsai K-T, Kuo C-Y, Lin P-H : High-frequency versus theta burst transcranial magnetic stimulation for the treatment of poststroke cognitive impairment in humans. Journal of psychiatry & neuroscience : JPN 2020;45(4):262-270 Pubmed Journal

337. Kongkasuwan R, Voraakhom K, Pisolayabutra P, Maneechai P, Boonin J, Kuptniratsaikul V : Creative art therapy to enhance rehabilitation for stroke patients: a randomized controlled trial. Clinical rehabilitation 2016;30(10):1016-1023 Pubmed

338. Gamito P, Oliveira J, Coelho C, Morais D, Lopes P, Pacheco J, et al. : Cognitive training on stroke patients via virtual reality-based serious games. Disability and rehabilitation 2017;39(4):385-388 Pubmed Journal

339. Chabriat H, Bassetti CL, Marx U, Audoli-Inthavong M-L, Sors A, Lambert E, et al. : Safety and efficacy of GABAA α5 antagonist S44819 in patients with ischaemic stroke: a multicentre, double-blind, randomised, placebo-controlled trial. The Lancet. Neurology 2020;19(3):226-233 Pubmed Journal

340. Park M-O, Lee S-H : Effects of cognitive-motor dual-task training combined with auditory motor synchronization training on cognitive functioning in individuals with chronic stroke: A pilot randomized controlled trial. Medicine 2018;97(22):e10910 Pubmed Journal

341. Gamito P, Oliveira J, Santos N, Pacheco J, Morais D, Saraiva T, et al. : Virtual exercises to promote cognitive recovery in stroke patients: The comparison between HMD vs screen exposure methods. International Journal on Disability and Human Development 2014;13(3):337-342 Journal

342. Bartolo M, Zucchella C, Capone A, Sandrini G, Pierelli F : An explorative study regarding the effect of l-deprenyl on cognitive and functional recovery in patients after stroke. Journal of the neurological sciences 2015;349(1-2):117-23 Pubmed Journal

343. Alvarez-Sabín J, Ortega G, Jacas C, Santamarina E, Maisterra O, Ribo M, et al. : Long-term treatment with citicoline may improve poststroke vascular cognitive impairment. Cerebrovascular diseases (Basel, Switzerland) 2013;35(2):146-54 Pubmed Journal

344. das Nair R, Cogger H, Worthington E, Lincoln NB : Cognitive rehabilitation for memory deficits after stroke. Cochrane Database of Systematic Reviews 2016;9(9):CD002293 Pubmed Journal

345. Silveira K, Smart CM : Cognitive, physical, and psychological benefits of yoga for acquired brain injuries: A systematic review of recent findings. Neuropsychological rehabilitation 2020;30(7):1388-1407 Pubmed Journal

346. Zheng G, Zhou W, Xia R, Tao J, Chen L : Aerobic Exercises for Cognition Rehabilitation following Stroke: A Systematic Review. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 2016;25(11):2780-2789 Pubmed Journal

347. Immink MA, Hillier S, Petkov J : Randomized controlled trial of yoga for chronic poststroke hemiparesis: motor function, mental health, and quality of life outcomes. Topics in stroke rehabilitation 2014;21(3):256-271 Pubmed Journal

348. De Luca R, Leonardi S, Spadaro L, Russo M, Aragona B, Torrisi M, et al. : Improving Cognitive Function in Patients with Stroke: Can Computerized Training Be the Future?. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 2018;27(4):1055-1060 Pubmed Journal

349. Tang A, Eng JJ, Krassioukov AV, Tsang TSM, Liu-Ambrose T : High- and low-intensity exercise do not improve cognitive function after stroke: A randomized controlled trial. Journal of rehabilitation medicine 2016;48(10):841-846 Pubmed Journal

350. Yeh T-T, Chang K-C, Wu C-Y : The Active Ingredient of Cognitive Restoration: A Multicenter Randomized Controlled Trial of Sequential Combination of Aerobic Exercise and Computer-Based Cognitive Training in Stroke Survivors With Cognitive Decline. Archives of physical medicine and rehabilitation 2019;100(5):821-827 Pubmed Journal

351. Withiel TD, Wong D, Ponsford JL, Cadilhac DA, New P, Mihaljcic T, et al. : Comparing memory group training and computerized cognitive training for improving memory function following stroke: A phase II randomized controlled trial. Journal of rehabilitation medicine 2019;51(5):343-351 Pubmed Journal

352. Zheng G, Zheng Y, Xiong Z, Ye B : Effect of Baduanjin exercise on cognitive function in patients with post-stroke cognitive impairment: a randomized controlled trial. Clin Rehabil 2020;34(8):1028-1039 Pubmed Journal Website

353. Särkämö T, Tervaniemi M, Laitinen S, Forsblom A, Soinila S, Mikkonen M, et al. : Music listening enhances cognitive recovery and mood after middle cerebral artery stroke. Brain : a journal of neurology 2008;131(Pt 3):866-876 Pubmed Journal

354. Music interventions for acquired brain injury [Data only. When citing this record quote "Cochrane Database of Systematic Reviews 2017, Issue 1".].

355. Withiel TD, Sharp VL, Wong D, Ponsford JL, Warren N, Stolwyk RJ : Understanding the experience of compensatory and

restorative memory rehabilitation: A qualitative study of stroke survivors. Neuropsychological rehabilitation 2020;30(3):503-522 Pubmed Journal

356. Sihvonen AJ, Leo V, Ripollés P, Lehtovaara T, Ylönen A, Rajanaro P, et al. : Vocal music enhances memory and language recovery after stroke: pooled results from two RCTs. Annals of clinical and translational neurology 2020;7(11):2272-2287 Pubmed Journal

357. Niemeijer M, Sværke KW, Christensen HK : The Effects of Computer Based Cognitive Rehabilitation in Stroke Patients with Working Memory Impairment: A Systematic Review. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 2020;29(12):105265 Pubmed Journal

358. Velikonja D, Tate R, Ponsford J, McIntyre A, Janzen S, Bayley M, et al. : INCOG recommendations for management of cognition following traumatic brain injury, part V: memory. The Journal of head trauma rehabilitation 29(4):369-86 Pubmed Journal

359. Lawson DW, Stolwyk RJ, Ponsford JL, McKenzie DP, Downing MG, Wong D : Telehealth Delivery of Memory Rehabilitation Following Stroke. Journal of the International Neuropsychological Society : JINS 2020;26(1):58-71 Pubmed Journal

360. Zucchella C, Capone A, Codella V, Vecchione C, Buccino G, Sandrini G, et al. : Assessing and restoring cognitive functions early after stroke. Functional neurology 29(4):255-62 Pubmed

361. Poulin V, Korner-Bitensky N, Dawson DR, Bherer L : Efficacy of executive function interventions after stroke: a systematic review. Topics in stroke rehabilitation 19(2):158-71 Pubmed Journal

362. Chung CS, Pollock A, Campbell T, Durward BR, Hagen S : Cognitive rehabilitation for executive dysfunction in adults with stroke or other adult non-progressive acquired brain damage. Cochrane Database of Systematic Reviews 2013; Pubmed Journal

363. Xu X-D, Ren H-Y, Prakash R, Vijayadas, Kumar R : Outcomes of neuropsychological interventions of stroke. Annals of Indian Academy of Neurology 2013;16(3):319-328 Journal Website

364. Skidmore ER, Dawson DR, Butters MA, Grattan ES, Juengst SB, Whyte EM, et al. : Strategy Training Shows Promise for Addressing Disability in the First 6 Months After Stroke. Neurorehabilitation and neural repair 2015;29(7):668-76 Pubmed Journal

365. Ihle-Hansen H, Thommessen B, Fagerland MW, Øksengård AR, Wyller TB, Engedal K, et al. : Multifactorial vascular risk factor intervention to prevent cognitive impairment after stroke and TIA: a 12-month randomized controlled trial. International journal of stroke : official journal of the International Stroke Society 2014;9(7):932-8 Pubmed Journal

366. Bartolo M, Zucchella C, Capone A, Sandrini G, Pierelli F : An explorative study regarding the effect of l-deprenyl on cognitive and functional recovery in patients after stroke. Journal of the neurological sciences 2015;349(1-2):117-23 Pubmed Journal

367. Alvarez-Sabín J, Ortega G, Jacas C, Santamarina E, Maisterra O, Ribo M, et al. : Long-term treatment with citicoline may improve poststroke vascular cognitive impairment. Cerebrovascular diseases (Basel, Switzerland) 2013;35(2):146-54 Pubmed Journal

368. Narasimhalu K, Effendy S, Sim CH, Lee JM, Chen I, Hia SB, et al. : A randomized controlled trial of rivastigmine in patients with cognitive impairment no dementia because of cerebrovascular disease. Acta neurologica Scandinavica 2010;121(4):217-24 Pubmed Journal

369. Faria AL, Pinho MS, Bermúdez I Badia S : A comparison of two personalization and adaptive cognitive rehabilitation approaches: a randomized controlled trial with chronic stroke patients. Journal of neuroengineering and rehabilitation 2020;17(1):78 Pubmed Journal

370. Poulin V, Korner-Bitensky N, Bherer L, Lussier M, Dawson DR : Comparison of two cognitive interventions for adults experiencing executive dysfunction post-stroke: a pilot study. Disability and rehabilitation 2017;39(1):1-13 Pubmed Journal

371. Park M-O, Lee S-H : Effect of a dual-task program with different cognitive tasks applied to stroke patients: A pilot randomized controlled trial. NeuroRehabilitation 2019;44(2):239-249 Pubmed Journal

372. van de Ven RM, Murre JMJ, Buitenweg JIV, Veltman DJ, Aaronson JA, Nijboer TCW, et al. : The influence of computer-based

cognitive flexibility training on subjective cognitive well-being after stroke: A multi-center randomized controlled trial. PloS one 2017;12(11):e0187582 Pubmed Journal

373. Lindsten-McQueen K, Weiner NW, Wang H-Y, Josman N, Connor LT : Systematic review of apraxia treatments to improve occupational performance outcomes. OTJR : occupation, participation and health 2014;34(4):183-92 Pubmed Journal

374. Dovern A, Fink GR, Weiss PH : Diagnosis and treatment of upper limb apraxia. Journal of neurology 2012;259(7):1269-83 Pubmed Journal

375. Luvizutto GJ, Bazan R, Braga GP, Resende LADL, Bazan SGZ, El Dib R : Pharmacological interventions for unilateral spatial neglect after stroke. Cochrane Database of Systematic Reviews 2015; Pubmed Journal

376. Luvizutto GJ, Bazan R, Braga GP, Resende LADL, Bazan SGZ, El Dib R : Pharmacological interventions for unilateral spatial neglect after stroke. The Cochrane database of systematic reviews 2015;(11):CD010882 Pubmed Journal

377. Sivan M, Neumann V, Kent R, Stroud A, Bhakta BB : Pharmacotherapy for treatment of attention deficits after non-progressive acquired brain injury. A systematic review. Clinical rehabilitation 2010;24(2):110-21 Pubmed Journal

378. Kim YK, Jung JH, Shin SH : A comparison of the effects of repetitive transcranial magnetic stimulation (rTMS) by number of stimulation sessions on hemispatial neglect in chronic stroke patients. Experimental brain research 2015;233(1):283-9 Pubmed Journal

379. Cha HG, Kim MK : Effects of repetitive transcranial magnetic stimulation on arm function and decreasing unilateral spatial neglect in subacute stroke: A randomized controlled trial. Clinical rehabilitation 2015; Pubmed

380. Bang D-H, Bong S-Y : Effect of combination of transcranial direct current stimulation and feedback training on visuospatial neglect in patients with subacute stroke: a pilot randomized controlled trial. Journal of physical therapy science 2015;27(9):2759-61 Pubmed Journal

381. Kim BR, Chun MH, Kim D-Y, Lee SJ : Effect of high- and low-frequency repetitive transcranial magnetic stimulation on visuospatial neglect in patients with acute stroke: a double-blind, sham-controlled trial. Archives of physical medicine and rehabilitation 2013;94(5):803-7 Pubmed Journal

382. Sunwoo H, Kim Y-H, Chang WH, Noh S, Kim E-J, Ko M-H : Effects of dual transcranial direct current stimulation on post-stroke unilateral visuospatial neglect. Neuroscience letters 2013;554 94-8 Pubmed Journal

383. Fu W, Song W, Zhang Y, Yang Y, Huo SU, Zhang R, et al. : Long-term effects of continuous theta-burst stimulation in visuospatial neglect. The Journal of international medical research 2015;43(2):196-203 Pubmed Journal

384. Koch G, Bonnì S, Giacobbe V, Bucchi G, Basile B, Lupo F, et al. : θ-burst stimulation of the left hemisphere accelerates recovery of hemispatial neglect. Neurology 2012;78(1):24-30 Pubmed Journal

385. Cazzoli D, Müri RM, Schumacher R, von Arx S, Chaves S, Gutbrod K, et al. : Theta burst stimulation reduces disability during the activities of daily living in spatial neglect. Brain : a journal of neurology 2012;135(Pt 11):3426-39 Pubmed Journal

386. Bowen A, Hazelton C, Pollock A, Lincoln NB : Cognitive rehabilitation for spatial neglect following stroke. The Cochrane database of systematic reviews 2013;(7):CD003586 Pubmed Journal

387. Klinke ME, Hafsteinsdóttir TB, Hjaltason H, Jónsdóttir H : Ward-based interventions for patients with hemispatial neglect in stroke rehabilitation: a systematic literature review. International journal of nursing studies 2015;52(8):1375-403 Pubmed Journal

388. Aparicio-López C, García-Molina A, García-Fernández J, Lopez-Blazquez R, Enseñat-Cantallops A, Sánchez-Carrión R, et al. : Cognitive rehabilitation with right hemifield eye-patching for patients with sub-acute stroke and visuo-spatial neglect: a randomized controlled trial. Brain injury 2015;29(4):501-7 Pubmed Journal

389. van Wyk A, Eksteen CA, Rheeder P : The effect of visual scanning exercises integrated into physiotherapy in patients with

unilateral spatial neglect poststroke: a matched-pair randomized control trial. Neurorehabilitation and neural repair 28(9):856-73 Pubmed Journal

390. Smania N, Fonte C, Picelli A, Gandolfi M, Varalta V : Effect of eye patching in rehabilitation of hemispatial neglect. Frontiers in human neuroscience 2013;7 527 Pubmed Journal

391. van Kessel ME, Geurts ACH, Brouwer WH, Fasotti L : Visual Scanning Training for Neglect after Stroke with and without a Computerized Lane Tracking Dual Task. Frontiers in human neuroscience 2013;7 358 Pubmed Journal

392. Cotoi A, Mirkowski M, Iruthayarajah J, Anderson R, Teasell R : The effect of theta-burst stimulation on unilateral spatial neglect following stroke: a systematic review. Clinical rehabilitation 2019;33(2):183-194 Pubmed Journal

393. Fan J, Li YI, Yang Y, Qu Y, Li S : Efficacy of Noninvasive Brain Stimulation on Unilateral Neglect After Stroke: A Systematic Review and Meta-analysis. American journal of physical medicine & rehabilitation 2018;97(4):261-269 Pubmed Journal

394. Kwon J-S : Therapeutic Intervention for Visuo-Spatial Neglect after Stroke: A Meta-Analysis of Randomized Controlled Trials. Osong public health and research perspectives 2018;9(2):59-65 Pubmed Journal

395. Ogourtsova T, Souza Silva W, Archambault PS, Lamontagne A : Virtual reality treatment and assessments for post-stroke unilateral spatial neglect: A systematic literature review. Neuropsychological rehabilitation 2017;27(3):409-454 Pubmed Journal

396. Salazar APS, Vaz PG, Marchese RR, Stein C, Pinto C, Pagnussat AS : Noninvasive Brain Stimulation Improves Hemispatial Neglect After Stroke: A Systematic Review and Meta-Analysis. Archives of physical medicine and rehabilitation 2018;99(2):355-366 Pubmed Journal

397. Svaerke K, Niemeijer M, Mogensen J, Christensen H : The effects of computer-based cognitive rehabilitation in patients with visuospatial neglect following stroke: a systematic review. Topics in stroke rehabilitation 2019;26(3):214-225 Pubmed Journal

398. Liu KPY, Hanly J, Fahey P, Fong SSM, Bye R : A Systematic Review and Meta-Analysis of Rehabilitative Interventions for Unilateral Spatial Neglect and Hemianopia Poststroke From 2006 Through 2016. Archives of physical medicine and rehabilitation 2019;100(5):956-979 Pubmed Journal

399. Knepley KD, Mao JZ, Wieczorek P, Okoye FO, Jain AP, Harel NY : Impact of Telerehabilitation for Stroke-Related Deficits. Telemedicine journal and e-health : the official journal of the American Telemedicine Association 2020; Pubmed Journal

400. Appleby E, Gill ST, Hayes LK, Walker TL, Walsh M, Kumar S : Effectiveness of telerehabilitation in the management of adults with stroke: A systematic review. PloS one 2019;14(11):e0225150 Pubmed Journal

401. Schröder J, van Criekinge T, Embrechts E, Celis X, Van Schuppen J, Truijen S, et al. : Combining the benefits of tele-rehabilitation and virtual reality-based balance training: a systematic review on feasibility and effectiveness. Disability and rehabilitation. Assistive technology 2019;14(1):2-11 Pubmed Journal

402. Sarfo FS, Ulasavets U, Opare-Sem OK, Ovbiagele B : Tele-Rehabilitation after Stroke: An Updated Systematic Review of the Literature. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 2018;27(9):2306-2318 Pubmed Journal

403. Chen J, Jin W, Zhang X-X, Xu W, Liu X-N, Ren C-C : Telerehabilitation Approaches for Stroke Patients: Systematic Review and Meta-analysis of Randomized Controlled Trials. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 2015;24(12):2660-8 Pubmed Journal

404. Tchero H, Tabue Teguo M, Lannuzel A, Rusch E : Telerehabilitation for Stroke Survivors: Systematic Review and Meta-Analysis. Journal of medical Internet research 2018;20(10):e10867 Pubmed Journal

405. Nordio S, Innocenti T, Agostini M, Meneghello F, Battel I : The efficacy of telerehabilitation in dysphagic patients: a systematic review. Acta otorhinolaryngologica Italica : organo ufficiale della Societa italiana di otorinolaringologia e chirurgia cervico-facciale 2018;38(2):79-85 Pubmed Journal

406. Cramer SC, Dodakian L, Le VU, See J, Augsburger R, McKenzie A, et al. : Efficacy of Home-Based Telerehabilitation vs In-Clinic Therapy for Adults After Stroke: A Randomized Clinical Trial. JAMA neurology 2019; Pubmed Journal

407. Maresca G, Maggio MG, Latella D, Cannavò A, De Cola MC, Portaro S, et al. : Toward Improving Poststroke Aphasia: A Pilot Study on the Growing Use of Telerehabilitation for the Continuity of Care. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 2019;28(10):104303 Pubmed Journal

408. Øra HP, Kirmess M, Brady MC, Partee I, Hognestad RB, Johannessen BB, et al. : The effect of augmented speech-language therapy delivered by telerehabilitation on poststroke aphasia-a pilot randomized controlled trial. Clinical rehabilitation 2020;34(3):369-381 Pubmed Journal

409. Saywell NL, Vandal AC, Mudge S, Hale L, Brown P, Feigin V, et al. : Telerehabilitation After Stroke Using Readily Available Technology: A Randomized Controlled Trial. Neurorehabilitation and neural repair 2021;35(1):88-97 Pubmed Journal

410. Torrisi M, Maresca G, De Cola MC, Cannavò A, Sciarrone F, Silvestri G, et al. : Using telerehabilitation to improve cognitive function in post-stroke survivors: is this the time for the continuity of care?. International journal of rehabilitation research. Internationale Zeitschrift fur Rehabilitationsforschung. Revue internationale de recherches de readaptation 2019;42(4):344-351 Pubmed Journal

411. Nascimento LR, Boening A, Galli A, Polese JC, Ada L : Treadmill walking improves walking speed and distance in ambulatory people after stroke and is not inferior to overground walking: a systematic review. Journal of physiotherapy 2021;67(2):95-104 Pubmed Journal

412. Zhang B, Li D, Liu Y, Wang J, Xiao Q : Virtual reality for limb motor function, balance, gait, cognition and daily function of stroke patients: A systematic review and meta-analysis. Journal of advanced nursing 2021; Pubmed Journal

413. Mehrholz J, Thomas S, Elsner B : Treadmill training and body weight support for walking after stroke. The Cochrane database of systematic reviews 2017;8 CD002840 Pubmed Journal

414. Zheng X, Wu X, Liu Z, Wang J, Wang K, Yin J, et al. : The Influences of Tai Chi on Balance Function and Exercise Capacity among Stroke Patients: A Meta-Analysis. Evidence-based complementary and alternative medicine : eCAM 2021;2021 6636847 Pubmed Journal

415. Xie Y-J, Chen YI, Tan H-X, Guo Q-F, Lau BW-M, Gao Q : Repetitive transcranial magnetic stimulation for lower extremity motor function in patients with stroke: a systematic review and network meta-analysis. Neural regeneration research 2021;16(6):1168-1176 Pubmed Journal

416. Wang LU, Zheng YU, Dang Y, Teng M, Zhang X, Cheng Y, et al. : Effects of robot-assisted training on balance function in patients with stroke: A systematic review and meta-analysis. Journal of rehabilitation medicine 2021;53(4):jrm00174 Pubmed Journal

417. Baniqued PDE, Stanyer EC, Awais M, Alazmani A, Jackson AE, Mon-Williams MA, et al. : Brain-computer interface robotics for hand rehabilitation after stroke: a systematic review. Journal of neuroengineering and rehabilitation 2021;18(1):15 Pubmed Journal

418. Alexander J, Dawson J, Langhorne P : Dynamic hand orthoses for the recovery of hand and arm function in adults after stroke: A systematic review and meta-analysis of randomised controlled trials. Topics in stroke rehabilitation 2021; 1-11 Pubmed Journal

419. Wu J, Cheng H, Zhang J, Yang S, Cai S : Robot-Assisted Therapy for Upper Extremity Motor Impairment After Stroke: A Systematic Review and Meta-Analysis. Physical therapy 2021;101(4): Pubmed Journal

420. English C, Hillier SL, Lynch EA : Circuit class therapy for improving mobility after stroke. The Cochrane database of systematic reviews 2017;6 CD007513 Pubmed Journal

421. Chiaramonte R, Vecchio M : Dysarthria and stroke. The effectiveness of speech rehabilitation. A systematic review and meta-analysis of the studies. European journal of physical and rehabilitation medicine 2021;57(1):24-43 Pubmed Journal

422. Finch E, Rumbach AF, Park S : Speech pathology management of non-progressive dysarthria: a systematic review of the literature. Disability and rehabilitation 2020;42(3):296-306 Pubmed Journal

423. Mitchell C, Bowen A, Tyson S, Butterfint Z, Conroy P : Interventions for dysarthria due to stroke and other adult-acquired, non-progressive brain injury. The Cochrane database of systematic reviews 2017;1 CD002088 Pubmed Journal

424. REhabilitation and recovery of peopLE with Aphasia after StrokE (RELEASE) Collaborators : Predictors of Poststroke Aphasia Recovery: A Systematic Review-Informed Individual Participant Data Meta-Analysis. Stroke 2021;52(5):1778-1787 Pubmed Journal

425. Palmer R, Dimairo M, Cooper C, Enderby P, Brady M, Bowen A, et al. : Self-managed, computerised speech and language therapy for patients with chronic aphasia post-stroke compared with usual care or attention control (Big CACTUS): a multicentre, single-blinded, randomised controlled trial. The Lancet. Neurology 2019;18(9):821-833 Pubmed Journal

426. Breitenstein C, Grewe T, Flöel A, Ziegler W, Springer L, Martus P, et al. : Intensive speech and language therapy in patients with chronic aphasia after stroke: a randomised, open-label, blinded-endpoint, controlled trial in a health-care setting. Lancet (London, England) 2017;389(10078):1528-1538 Pubmed Journal

427. Nouwens F, de Lau LM, Visch-Brink EG, van de Sandt-Koenderman WM, Lingsma HF, Goosen S, et al. : Efficacy of early cognitive-linguistic treatment for aphasia due to stroke: A randomised controlled trial (Rotterdam Aphasia Therapy Study-3). European stroke journal 2017;2(2):126-136 Pubmed Journal

428. Godecke E, Armstrong E, Rai T, Ciccone N, Rose ML, Middleton S, et al. : A randomized control trial of intensive aphasia therapy after acute stroke: The Very Early Rehabilitation for SpEech (VERSE) study. International journal of stroke : official journal of the International Stroke Society 2020; 1747493020961926 Pubmed Journal

429. Barwood CHS, Murdoch BE, Riek S, O'Sullivan JD, Wong A, Lloyd D, et al. : Long term language recovery subsequent to low frequency rTMS in chronic non-fluent aphasia. NeuroRehabilitation 2013;32(4):915-28 Pubmed Journal

430. Hong Z, Zheng H, Luo J, Yin M, Ai Y, Deng B, et al. : Effects of Low-Frequency Repetitive Transcranial Magnetic Stimulation on Language Recovery in Poststroke Survivors With Aphasia: An Updated Meta-analysis. Neurorehabilitation and neural repair 2021; 15459683211011230 Pubmed Journal

431. Zhang J, Wei R, Chen Z, Luo B : Piracetam for Aphasia in Post-stroke Patients: A Systematic Review and Meta-analysis of Randomized Controlled Trials. CNS drugs 2016;30(7):575-87 Pubmed Journal

432. Simmons-Mackie N, Raymer A, Cherney LR : Communication Partner Training in Aphasia: An Updated Systematic Review. Archives of physical medicine and rehabilitation 2016;97(12):2202-2221.e8 Pubmed Journal

433. Simmons-Mackie N, Raymer A, Armstrong E, Holland A, Cherney LR : Communication partner training in aphasia: a systematic review. Archives of physical medicine and rehabilitation 2010;91(12):1814-37 Pubmed Journal

434. Eriksson K, Forsgren E, Hartelius L, Saldert C : Communication partner training of enrolled nurses working in nursing homes with people with communication disorders caused by stroke or Parkinson's disease. Disability and rehabilitation 2016;38(12):1187-203 Pubmed Journal

435. Chang HF, Power E, O'Halloran R, Foster A : Stroke communication partner training: a national survey of 122 clinicians on current practice patterns and perceived implementation barriers and facilitators. International journal of language & communication disorders 2018;53(6):1094-1109 Pubmed Journal

436. Shrubsole K, Lin T-J, Burton C, Scott J, Finch E : Delivering an iterative Communication Partner Training programme to multidisciplinary healthcare professionals: A pilot implementation study and process evaluation. International journal of language & communication disorders 2021;56(3):620-636 Pubmed Journal

437. Heard R, O'Halloran R, McKinley K : Communication partner training for health care professionals in an inpatient rehabilitation setting: A parallel randomised trial. International journal of speech-language pathology 2017;19(3):277-286 Pubmed Journal

438. Cameron A, McPhail S, Hudson K, Fleming J, Lethlean J, Finch E : Telepractice communication partner training for health professionals: A randomised trial. Journal of communication disorders 81 105914 Pubmed Journal

439. Power E, Falkenberg K, Barnes S, Elbourn E, Attard M, Togher L : A pilot randomized controlled trial comparing online versus face-to-face delivery of an aphasia communication partner training program for student healthcare professionals. International journal of language & communication disorders 2020;55(6):852-866 Pubmed Journal

440. Finch E, Lethlean J, Rose T, Fleming J, Theodoros D, Cameron A, et al. : Conversations between people with aphasia and speech pathology students via telepractice: A Phase II feasibility study. International journal of language & communication disorders 2020;55(1):43-58 Pubmed Journal

441. Finch E, Fleming J, Cameron A, Lethlean J, Hudson K, Dassanayake S, et al. : Is an educational lecture a critical component of communication partner training?. International journal of speech-language pathology 2018;20(7):779-789 Pubmed Journal

442. Finch E, Cameron A, Fleming J, Lethlean J, Hudson K, McPhail S : Does communication partner training improve the conversation skills of speech-language pathology students when interacting with people with aphasia?. Journal of communication disorders 2017;68 1-9 Pubmed Journal

443. : Dosage, Intensity, and Frequency of Language Therapy for Aphasia: A Systematic Review-Based, Individual Participant Data Network Meta-Analysis. Stroke 2021; STROKEAHA121035216 Pubmed Journal

444. Mackenzie C, Paton G, Kelly S, Brady M, Muir M : The living with dysarthria group: implementation and feasibility of a group intervention for people with dysarthria following stroke and family members. International journal of language & communication disorders 47(6):709-24 Pubmed Journal

445. Park S, Theodoros D, Finch E, Cardell E : Be Clear: A New Intensive Speech Treatment for Adults With Nonprogressive Dysarthria. American journal of speech-language pathology 2016;25(1):97-110 Pubmed Journal

446. Wenke R, Theodoros D.G., Cornwell PL : A comparison of the effects of the Lee Silverman Voice Treatment and traditional therapy on intelligibility, perceptual speech features, and everyday communication in nonprogressive dysarthria.

447. Choo YJ, Chang MC : Effectiveness of an ankle-foot orthosis on walking in patients with stroke: a systematic review and meta-analysis. Scientific reports 2021;11(1):15879 Pubmed Journal

448. Wada Y, Otaka Y, Mukaino M, Tsujimoto Y, Shiroshita A, Kawate N, et al. : The effect of ankle-foot orthosis on ankle kinematics in individuals after stroke: A systematic review and meta-analysis. PM & R : the journal of injury, function, and rehabilitation 2021; Pubmed Journal

449. Daryabor A, Kobayashi T, Yamamoto S, Lyons SM, Orendurff M, Akbarzadeh Baghban A : Effect of ankle-foot orthoses on functional outcome measurements in individuals with stroke: a systematic review and meta-analysis. Disability and rehabilitation 2021; 1-16 Pubmed Journal

450. Zhou Q, Yang H, Zhou Q, Pan H : Effects of cognitive motor dual-task training on stroke patients: A RCT-based meta-analysis. Journal of clinical neuroscience : official journal of the Neurosurgical Society of Australasia 2021;92 175-182 Pubmed Journal

451. Comino-Suárez N, Moreno JC, Gómez-Soriano J, Megía-García Á, Serrano-Muñoz D, Taylor J, et al. : Transcranial direct current stimulation combined with robotic therapy for upper and lower limb function after stroke: a systematic review and meta-analysis of randomized control trials. Journal of neuroengineering and rehabilitation 2021;18(1):148 Pubmed Journal

452. Zughbor N, Alwahshi A, Abdelrahman R, Elnekiti Z, Elkareish H, Gabor MG, et al. : The Effect of Water-Based Therapy Compared to Land-Based Therapy on Balance and Gait Parameters of Patients with Stroke: A Systematic Review. European neurology 2021;84(6):409-417 Pubmed Journal

453. Legg LA, Rudberg A-S, Hua X, Wu S, Hackett ML, Tilney R, et al. : Selective serotonin reuptake inhibitors (SSRIs) for stroke recovery. The Cochrane database of systematic reviews 2021;11 CD009286 Pubmed Journal

454. Carragher M, Steel G, O'Halloran R, Torabi T, Johnson H, Taylor NF, et al. : Aphasia disrupts usual care: the stroke team's perceptions of delivering healthcare to patients with aphasia. Disability and rehabilitation 2021;43(21):3003-3014 Pubmed Journal

455. van Rijssen M, Isaksen J, Vandenborre D, Veldkamp M, Bryon E, Remijn L, et al. : Ways to improve communication and support in healthcare centres according to people with aphasia and their relatives: a Dutch perspective. null 2021; 1-14 Journal Website

456. Hur Y, Kang Y : Nurses' experiences of communicating with patients with aphasia. Nursing open 2022;9(1):714-720 Pubmed Journal

457. Russo MJ, Prodan V, Meda NN, Carcavallo L, Muracioli A, Sabe L, et al. : High-technology augmentative communication for adults with post-stroke aphasia: a systematic review. Expert review of medical devices 2017;14(5):355-370 Pubmed Journal

458. Hayward KS, Kramer SF, Dalton EJ, Hughes GR, Brodtmann A, Churilov L, et al. : Timing and Dose of Upper Limb Motor Intervention After Stroke: A Systematic Review. Stroke 2021;52(11):3706-3717 Pubmed Journal

459. Jee S, Jeong M, Paik N-J, Kim W-S, Shin Y-I, Ko S-H, et al. : Early Supported Discharge and Transitional Care Management After Stroke: A Systematic Review and Meta-Analysis. Frontiers in neurology 2022;13 755316 Pubmed Journal

460. Hyun S-J, Lee J, Lee B-H : The Effects of Sit-to-Stand Training Combined with Real-Time Visual Feedback on Strength, Balance, Gait Ability, and Quality of Life in Patients with Stroke: A Randomized Controlled Trial. International journal of environmental research and public health 2021;18(22): Pubmed Journal

461. da Rosa Pinheiro DR, Cabeleira MEP, da Campo LA, Corrêa PS, Blauth AHEG, Cechetti F : Effects of aerobic cycling training on mobility and functionality of acute stroke subjects: A randomized clinical trial. NeuroRehabilitation 2021;48(1):39-47 Pubmed Journal

462. Zhao M, Wang G, Wang A, Cheng LJ, Lau Y : Robot-assisted distal training improves upper limb dexterity and function after stroke: a systematic review and meta-regression. Neurological sciences : official journal of the Italian Neurological Society and of the Italian Society of Clinical Neurophysiology 2022;43(3):1641-1657 Pubmed Journal

463. Dromerick AW, Geed S, Barth J, Brady K, Giannetti ML, Mitchell A, et al. : Critical Period After Stroke Study (CPASS): A phase II clinical trial testing an optimal time for motor recovery after stroke in humans. Proceedings of the National Academy of Sciences of the United States of America 2021;118(39): Pubmed Journal

464. Wang W, Wei M, Cheng Y, Zhao H, Du H, Hou W, et al. : Safety and Efficacy of Early Rehabilitation After Stroke Using Mechanical Thrombectomy: A Pilot Randomized Controlled Trial. Frontiers in neurology 2022;13 698439 Pubmed Journal

465. Clark B, Whitall J, Kwakkel G, Mehrholz J, Ewings S, Burridge J : The effect of time spent in rehabilitation on activity limitation and impairment after stroke. The Cochrane database of systematic reviews 2021;10(10):CD012612 Pubmed Journal

466. Kim D-H, In T-S, Jung K-S : Effects of robot-assisted trunk control training on trunk control ability and balance in patients with stroke: A randomized controlled trial. Technology and health care : official journal of the European Society for Engineering and Medicine 30(2):413-422 Pubmed Journal

467. Zhao J, Chau JPC, Chan AWK, Meng Q, Choi KC, Xiang X, et al. : Tailored Sitting Tai Chi Program for Subacute Stroke Survivors: A Randomized Controlled Trial. Stroke 53(7):2192-2203 Pubmed Journal

468. Alwashmi K, Meyer G, Rowe FJ : Audio-visual stimulation for visual compensatory functions in stroke survivors with visual field defect: a systematic review. Neurological sciences : official journal of the Italian Neurological Society and of the Italian Society of Clinical Neurophysiology 43(4):2299-2321 Pubmed Journal

469. El Nahas N, Elbokl AM, Abd Eldayem EH, Roushdy TM, Amin RM, Helmy SM, et al. : Navigated perilesional transcranial magnetic stimulation can improve post-stroke visual field defect: A double-blind sham-controlled study. Restorative neurology and neuroscience 39(3):199-207 Pubmed Journal

470. Anjos JM, Neto MG, Dos Santos FS, Almeida KDO, Bocchi EA, Lima Bitar YDS, et al. : The impact Of high-intensity interval training On functioning And health-related quality Of life In post-stroke patients: A systematic review With meta-analysis. Clinical rehabilitation 36(6):726-739 Pubmed Journal

471. Fabero-Garrido R, Del Corral T, Angulo-Díaz-Parreño S, Plaza-Manzano G, Martín-Casas P, Cleland JA, et al. : Respiratory muscle

training improves exercise tolerance and respiratory muscle function/structure post-stroke at short term: A systematic review and meta-analysis. Annals of physical and rehabilitation medicine 65(5):101596 Pubmed Journal

472. Machado N, Wingfield M, Kramer S, Olver J, Williams G, Johnson L : Maintenance of Cardiorespiratory Fitness in People With Stroke: A Systematic Review and Meta-analysis. Archives of physical medicine and rehabilitation 103(7):1410-1421.e6 Pubmed Journal

473. Anjos JM, Neto MG, de Araújo Tapparelli Y, Tse G, Biondi-Zoccai G, de Souza Lima Bitar Y, et al. : Efficacy and safety of very early mobilization after thrombolysis in acute ischemic stroke: a randomized clinical trial. Journal of neurology 270(2):843-850 Pubmed Journal

474. Thijs L, Voets E, Denissen S, Mehrholz J, Elsner B, Lemmens R, et al. : Trunk training following stroke. The Cochrane database of systematic reviews 3(3):CD013712 Pubmed Journal

475. Toh SFM, Chia PF, Fong KNK : Effectiveness of home-based upper limb rehabilitation in stroke survivors: A systematic review and meta-analysis. Frontiers in neurology 13 964196 Pubmed Journal

476. Qin P, Cai C, Chen X, Wei X : Effect of home-based interventions on basic activities of daily living for patients who had a stroke: a systematic review with meta-analysis. BMJ open 12(7):e056045 Pubmed Journal

477. Bok S-K, Song Y, Lim A, Jin S, Kim N, Ko G : High-Tech Home-Based Rehabilitation after Stroke: A Systematic Review and Meta-Analysis. Journal of clinical medicine 12(7): Pubmed Journal

478. Nascimento LR, Rocha RJ, Boening A, Ferreira GP, Perovano MC : Home-based exercises are as effective as equivalent doses of centre-based exercises for improving walking speed and balance after stroke: a systematic review. Journal of physiotherapy 68(3):174-181 Pubmed Journal

479. Aravantinou-Fatorou K, Fotakopoulos G : Efficacy of exercise rehabilitation program accompanied by experiential music for recovery of aphasia in single cerebrovascular accidents: a randomized controlled trial. Irish journal of medical science 190(2):771-778 Pubmed Journal

480. Braley M, Pierce JS, Saxena S, De Oliveira E, Taraboanta L, Anantha V, et al. : A Virtual, Randomized, Control Trial of a Digital Therapeutic for Speech, Language, and Cognitive Intervention in Post-stroke Persons With Aphasia. Frontiers in neurology 12 626780 Pubmed Journal

481. Cao Y, Huang X, Zhang B, Kranz GS, Zhang D, Li X, et al. : Effects of virtual reality in post-stroke aphasia: a systematic review and meta-analysis. Neurological sciences : official journal of the Italian Neurological Society and of the Italian Society of Clinical Neurophysiology 42(12):5249-5259 Pubmed Journal

482. Devane N, Behn N, Marshall J, Ramachandran A, Wilson S, Hilari K : The use of virtual reality in the rehabilitation of aphasia: a systematic review. Disability and rehabilitation 1-20 Pubmed Journal

483. Ding X, Zhang S, Huang W, Zhang S, Zhang LI, Hu J, et al. : Comparative efficacy of non-invasive brain stimulation for post-stroke aphasia: A network meta-analysis and meta-regression of moderators. Neuroscience and biobehavioral reviews 140 104804 Pubmed Journal

484. Feng S, Tang M, Huang G, Wang J, Lv Y, He S, et al. : Comparison of the efficacy of acupuncture-related Therapies for post-stroke motor aphasia: A Bayesian network meta-analysis. Frontiers in neurology 13 992079 Pubmed Journal

485. Fleming V, Brownsett S, Krason A, Maegli MA, Coley-Fisher H, Ong Y-H, et al. : Efficacy of spoken word comprehension therapy in patients with chronic aphasia: a cross-over randomised controlled trial with structural imaging. Journal of neurology, neurosurgery, and psychiatry 92(4):418-24 Pubmed Journal

486. Gholami M, Pourbaghi N, Taghvatalab S : Evaluation of rTMS in patients with poststroke aphasia: a systematic review and focused meta-analysis. Neurological sciences : official journal of the Italian Neurological Society and of the Italian Society of Clinical Neurophysiology 43(8):4685-4694 Pubmed Journal

487. Haro-Martínez A, Pérez-Araujo CM, Sanchez-Caro JM, Fuentes B, Díez-Tejedor E : Melodic Intonation Therapy for Post-stroke Non-fluent Aphasia: Systematic Review and Meta-Analysis. Frontiers in neurology 12 700115 Pubmed Journal

488. Popescu T, Stahl B, Wiernik BM, Haiduk F, Zemanek M, Helm H, et al. : Melodic Intonation Therapy for aphasia: A multi-level meta-analysis of randomized controlled trials and individual participant data. Annals of the New York Academy of Sciences 1516(1):76-84 Pubmed Journal

489. Kielar A, Patterson D, Chou Y-H : Efficacy of repetitive transcranial magnetic stimulation in treating stroke aphasia: Systematic review and meta-analysis. Clinical neurophysiology : official journal of the International Federation of Clinical Neurophysiology 140 196-227 Pubmed Journal

490. Lee I-T, Huang C-C, Hsu P-C, Lin C-P, Tsai P-Y : Resting-State Network Changes Following Transcranial Magnetic Stimulation in Patients With Aphasia-A Randomized Controlled Study. Neuromodulation : journal of the International Neuromodulation Society 25(4):528-537 Pubmed Journal

491. Liang P, Li Y, Feng Y, Yin G, Chen S, Liu X, et al. : Effects of Acupuncture-Related Therapies in the Rehabilitation of Patients with Post-Stroke Aphasia-A Network Meta-Analysis of Randomized Controlled Trials. Brain sciences 12(10): Pubmed Journal

492. Menahemi-Falkov M, Breitenstein C, Pierce JE, Hill AJ, O'Halloran R, Rose ML : A systematic review of maintenance following intensive therapy programs in chronic post-stroke aphasia: importance of individual response analysis. Disability and rehabilitation 44(20):5811-5826 Pubmed Journal

493. Cacciante L, Kiper P, Garzon M, Baldan F, Federico S, Turolla A, et al. : Telerehabilitation for people with aphasia: A systematic review and meta-analysis. Journal of communication disorders 92 106111 Pubmed Journal

494. Yang S, Li LI, Jiang R, Ding H, Xu F, Ge L, et al. : Tongue Acupuncture for the Treatment of Poststroke Aphasia: A Systematic Review and Meta-Analysis. Evidence-based complementary and alternative medicine : eCAM 2022 4731074 Pubmed Journal

495. Shi Y, Hu C, Li S, Huang T, Chen X, Li G, et al. : The Effects of Electroacupuncture as an Adjunct Therapy on Poststroke Aphasia: A Systematic Review and Meta-Analysis. Evidence-based complementary and alternative medicine : eCAM 2022 1271205 Pubmed Journal

496. Fu Q-W, Liu M, Zhang L-Z, Yang H, Zhang L-Q, Yang S-S, et al. : Head Acupuncture Plus Schuell's Language Rehabilitation for Post-Stroke Aphasia: A Systematic Review and Meta-Analysis of 32 Randomized Controlled Trials. Chinese journal of integrative medicine 28(8):743-752 Pubmed Journal

497. Spaccavento S, Falcone R, Cellamare F, Picciola E, Glueckauf RL : Effects of computer-based therapy versus therapist-mediated therapy in stroke-related aphasia: Pilot non-inferiority study. Journal of communication disorders 94 106158 Pubmed Journal

498. Rose ML, Nickels L, Copland D, Togher L, Godecke E, Meinzer M, et al. : Results of the COMPARE trial of Constraint-induced or Multimodality Aphasia Therapy compared with usual care in chronic post-stroke aphasia. Journal of neurology, neurosurgery, and psychiatry 93(6):573-581 Pubmed Journal

499. Zhang J, Zhong D, Xiao X, Yuan LI, Li Y, Zheng Y, et al. : Effects of repetitive transcranial magnetic stimulation (rTMS) on aphasia in stroke patients: A systematic review and meta-analysis. Clinical rehabilitation 35(8):1103-1116 Pubmed Journal

500. Zumbansen A, Black SE, Chen JL, J Edwards D, Hartmann A, Heiss W-D, et al. : Non-invasive brain stimulation as add-on therapy for subacute post-stroke aphasia: a randomized trial (NORTHSTAR). European stroke journal 5(4):402-413 Pubmed Journal

501. Zumbansen A, Kneifel H, Lazzouni L, Ophey A, Black SE, Chen JL, et al. : Differential Effects of Speech and Language Therapy and rTMS in Chronic Versus Subacute Post-stroke Aphasia: Results of the NORTHSTAR-CA Trial. Neurorehabilitation and neural repair 36(4-5):306-316 Pubmed Journal

502. Zheng K, Xu X, Ji Y, Fang H, Gao F, Huang G, et al. : Continuous theta burst stimulation-induced suppression of the right fronto-thalamic-cerebellar circuit accompanies improvement in language performance in poststroke aphasia: A resting-state fMRI study. Frontiers in aging neuroscience 14 1079023 Pubmed Journal

503. You LI, Wang Y, Chen W, Zhang S, Rao J, Liu LI, et al. : The Effectiveness of Action Observation Therapy Based on Mirror Neuron Theory in Chinese Patients with Apraxia of Speech after Stroke. European neurology 81(5-6):278-286 Pubmed Journal

504. Adamit T, Shames J, Rand D : Effectiveness of the Functional and Cognitive Occupational Therapy (FaCoT) Intervention for Improving Daily Functioning and Participation of Individuals with Mild Stroke: A Randomized Controlled Trial. International journal of environmental research and public health 18(15): Pubmed Journal

505. Ahmed I, Mustafaoglu R, Benkhalifa N, Yakhoub YH : Does noninvasive brain stimulation combined with other therapies improve upper extremity motor impairment, functional performance, and participation in activities of daily living after stroke? A systematic review and meta-analysis of randomized controlled trial. Topics in stroke rehabilitation 30(3):213-234 Pubmed Journal

506. Alsubiheen AM, Choi W, Yu W, Lee H : The Effect of Task-Oriented Activities Training on Upper-Limb Function, Daily Activities, and Quality of Life in Chronic Stroke Patients: A Randomized Controlled Trial. International journal of environmental research and public health 19(21): Pubmed Journal

507. Batool S, Zafar H, Gilani SA, Ahmad A, Hanif A : Effects of visual scanning exercises in addition to task specific approach on balance and activities of daily livings in post stroke patients with eye movement disorders: a randomized controlled trial. BMC neurology 22(1):312 Pubmed Journal

508. Chen X, Liu F, Lin S, Yu L, Lin R : Effects of Virtual Reality Rehabilitation Training on Cognitive Function and Activities of Daily Living of Patients With Poststroke Cognitive Impairment: A Systematic Review and Meta-Analysis. Archives of physical medicine and rehabilitation 103(7):1422-1435 Pubmed Journal

509. Fallahpour M, Eriksson G, Guidetti S : Changes in Perceived Impact of Stroke on Everyday Life over Five Years in a Rehabilitation Sample that Received an Activity of Daily Living Intervention: A Follow-Up Study. Journal of rehabilitation medicine 54 jrm00291 Pubmed Journal

510. Wei J, Zhu X, Xia L, Zhao Y, Yang G, Han Q, et al. : Intermittent pneumatic compression combined with rehabilitation training improves motor function deficits in patients with acute cerebral infarction. Acta neurologica Belgica 121(6):1561-1566 Pubmed Journal

511. Choi W : Effects of Cognitive Exercise Therapy on Upper Extremity Sensorimotor Function and Activities of Daily Living in Patients with Chronic Stroke: A Randomized Controlled Trial. Healthcare (Basel, Switzerland) 10(3): Pubmed Journal

512. Gibson E, Koh C-L, Eames S, Bennett S, Scott AM, Hoffmann TC : Occupational therapy for cognitive impairment in stroke patients. The Cochrane database of systematic reviews 3(3):CD006430 Pubmed Journal

513. Leong SC, Tang YM, Toh FM, Fong KNK : Examining the effectiveness of virtual, augmented, and mixed reality (VAMR) therapy for upper limb recovery and activities of daily living in stroke patients: a systematic review and meta-analysis. Journal of neuroengineering and rehabilitation 19(1):93 Pubmed Journal

514. Deng P, Zhao Z, Zhang S, Xiao T, Li YI : Effect of kinesio taping on hemiplegic shoulder pain: A systematic review and meta-analysis of randomized controlled trials. Clinical rehabilitation 35(3):317-331 Pubmed Journal

515. Pinto EF, Gupta A, Kulkarni GB, Andrade C : A Randomized, Double-Blind, Sham-Controlled Study of Transcranial Direct Current Stimulation as an Augmentation Intervention for the Attenuation of Motor Deficits in Patients With Stroke. The journal of ECT 37(4):281-290 Pubmed Journal

516. Moon J-H, Cho H-Y, Hahm S-C : Influence of Electrotherapy with Task-Oriented Training on Spasticity, Hand Function, Upper Limb Function, and Activities of Daily Living in Patients with Subacute Stroke: A Double-Blinded, Randomized, Controlled Trial. Healthcare (Basel, Switzerland) 9(8): Pubmed Journal

517. Park J-H : Effects of mental imagery training combined electromyogram-triggered neuromuscular electrical stimulation on upper limb function and activities of daily living in patients with chronic stroke: a randomized controlled trial. Disability and rehabilitation 42(20):2876-2881 Pubmed Journal

518. Chen X, Liu F, Lyu Z, Xiu H, Hou Y, Tu S : High-frequency repetitive transcranial magnetic stimulation (HF-rTMS) impacts activities of daily living of patients with post-stroke cognitive impairment: a systematic review and meta-analysis. Neurological sciences : official

journal of the Italian Neurological Society and of the Italian Society of Clinical Neurophysiology Pubmed Journal

519. Chen Y, Yang L, Li X, Tang LU, Pi Y, Bai D : Non-invasive brain stimulation for limb motor function and daily living activity improvement in acute stroke: A meta-analysis. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 32(4):106982 Pubmed Journal

520. Nindorera F, Nduwimana I, Sinzakaraye A, Havyarimana E, Bleyenheuft Y, Thonnard J-L, et al. : Effect of mixed and collective physical activity in chronic stroke rehabilitation: A randomized cross-over trial in low-income settings. Annals of physical and rehabilitation medicine 66(4):101704 Pubmed Journal

521. Zhang B, Wong KP, Kang R, Fu S, Qin J, Xiao Q : Efficacy of robot-assisted and virtual reality interventions on balance, gait, and daily function in patients with stroke: A systematic review and network meta-analysis. Archives of physical medicine and rehabilitation Pubmed Journal

522. Zhuang J-Y, Ding LI, Shu B-B, Chen D, Jia J : Associated Mirror Therapy Enhances Motor Recovery of the Upper Extremity and Daily Function after Stroke: A Randomized Control Study. Neural plasticity 2021 7266263 Pubmed Journal

523. Nogueira NGDHM, Parma JO, Leão SESDA, Sales IDS, Macedo LC, Galvão ACDR, et al. : Mirror therapy in upper limb motor recovery and activities of daily living, and its neural correlates in stroke individuals: A systematic review and meta-analysis. Brain research bulletin 177 217-238 Pubmed Journal

524. Wen X, Li LI, Li X, Zha H, Liu Z, Peng Y, et al. : Therapeutic Role of Additional Mirror Therapy on the Recovery of Upper Extremity Motor Function after Stroke: A Single-Blind, Randomized Controlled Trial. Neural plasticity 2022 8966920 Pubmed Journal

525. Park Y-S, An C-S, Lim C-G : Effects of a Rehabilitation Program Using a Wearable Device on the Upper Limb Function, Performance of Activities of Daily Living, and Rehabilitation Participation in Patients with Acute Stroke. International journal of environmental research and public health 18(11): Pubmed Journal

526. Mugisha S, Job M, Zoppi M, Testa M, Molfino R : Computer-Mediated Therapies for Stroke Rehabilitation: A Systematic Review and Meta-Analysis. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 31(6):106454 Pubmed Journal

527. Nie P, Liu F, Lin S, Guo J, Chen X, Chen S, et al. : The effects of computer-assisted cognitive rehabilitation on cognitive impairment after stroke: A systematic review and meta-analysis. Journal of clinical nursing 31(9-10):1136-1148 Pubmed Journal

528. Yu J-A, Park J : The effect of first-person perspective action observation training on upper extremity function and activity of daily living of chronic stroke patients. Brain and behavior 12(5):e2565 Pubmed Journal

529. de Azevedo JA, Barbosa FDS, Seixas VM, da Silva Scipioni KRD, Sampaio PYS, da Cruz DMC, et al. : Effects of constraint-induced movement therapy on activity and participation after a stroke: Systematic review and meta-analysis. Frontiers in human neuroscience 16 987061 Pubmed Journal

530. Saragih ID, Tarihoran DETAU, Batubara SO, Tzeng H-M, Lin C-J : Effects of telehealth interventions on performing activities of daily living and maintaining balance in stroke survivors: A systematic review and meta-analysis of randomised controlled studies. Journal of clinical nursing 31(19-20):2678-2690 Pubmed Journal

531. Yang X, Shi L, Ran D, Li M, Qin C, An Z : The treatment of post-stroke dysarthria with a combination of different acupuncture types and language rehabilitation training: a systematic review and network meta-analysis. Annals of translational medicine 10(23):1281 Pubmed Journal

532. Pisano F, Caltagirone C, Incoccia C, Marangolo P : Spinal or cortical direct current stimulation: Which is the best? Evidence from apraxia of speech in post-stroke aphasia. Behavioural brain research 399 113019 Pubmed Journal

533. Zhang Y, Qiu X, Chen J, Ji C, Wang F, Song D, et al. : Effects of exercise therapy on patients with poststroke cognitive impairment: A systematic review and meta-analysis. Frontiers in neuroscience 17 1164192 Pubmed Journal

534. Li K-P, Sun J, Wu C-Q, An X-F, Wu J-J, Zheng M-X, et al. : Effects of repetitive transcranial magnetic stimulation on post-stroke patients with cognitive impairment: A systematic review and meta-analysis. Behavioural brain research 439 114229 Pubmed Journal

535. Li X, Geng DI, Wang S, Sun G : Aerobic exercises and cognitive function in post-stroke patients: A systematic review with meta-analysis. Medicine 101(41):e31121 Pubmed Journal

536. Zhou Y, Feng H, Li G, Xu C, Wu Y, Li H : Efficacy of computerized cognitive training on improving cognitive functions of stroke patients: A systematic review and meta-analysis of randomized controlled trials. International journal of nursing practice 28(3):e12966 Pubmed Journal

537. Peers PV, Punton SF, Murphy FC, Watson P, Bateman A, Duncan J, et al. : A randomized control trial of the effects of home-based online attention training and working memory training on cognition and everyday function in a community stroke sample. Neuropsychological rehabilitation 32(10):2603-2627 Pubmed Journal

538. Zhang QI, Fu YU, Lu Y, Zhang Y, Huang Q, Yang Y, et al. : Impact of Virtual Reality-Based Therapies on Cognition and Mental Health of Stroke Patients: Systematic Review and Meta-analysis. Journal of medical Internet research 23(11):e31007 Pubmed Journal

539. Gao Y, Ma LU, Lin C, Zhu S, Yao L, Fan H, et al. : Effects of Virtual Reality-Based Intervention on Cognition, Motor Function, Mood, and Activities of Daily Living in Patients With Chronic Stroke: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Frontiers in aging neuroscience 13 766525 Pubmed Journal

540. Hara T, Shanmugalingam A, McIntyre A, Burhan AM : The Effect of Non-Invasive Brain Stimulation (NIBS) on Attention and Memory Function in Stroke Rehabilitation Patients: A Systematic Review and Meta-Analysis. Diagnostics (Basel, Switzerland) 11(2): Pubmed Journal

541. Gao Y, Qiu Y, Yang Q, Tang S, Gong J, Fan H, et al. : Repetitive transcranial magnetic stimulation combined with cognitive training for cognitive function and activities of daily living in patients with post-stroke cognitive impairment: A systematic review and meta-analysis. Ageing research reviews 87 101919 Pubmed Journal

542. O'Donoghue M, Leahy S, Boland P, Galvin R, McManus J, Hayes S : Rehabilitation of Cognitive Deficits Poststroke: Systematic Review and Meta-Analysis of Randomized Controlled Trials. Stroke 53(5):1700-1710 Pubmed Journal

543. Xu W-W, Liao Q-H, Zhu D-W : The effect of transcranial magnetic stimulation on the recovery of attention and memory impairment following stroke: a systematic review and meta-analysis. Expert review of neurotherapeutics 22(11-12):1031-1041 Pubmed Journal

544. Potter T, Lioutas V-A, Tano M, Pan A, Meeks J, Woo D, et al. : Cognitive Impairment After Intracerebral Hemorrhage: A Systematic Review of Current Evidence and Knowledge Gaps. Frontiers in neurology 12 716632 Pubmed Journal

545. Lee S, Cha H : The effect of clinical application of transcranial direct current stimulation combined with non-immersive virtual reality rehabilitation in stroke patients. Technology and health care : official journal of the European Society for Engineering and Medicine 30(1):117-127 Pubmed Journal

546. Pisano F, Manfredini A, Castellano A, Caltagirone C, Marangolo P : Does Executive Function Training Impact on Communication? A Randomized Controlled tDCS Study on Post-Stroke Aphasia. Brain sciences 12(9): Pubmed Journal

547. Liu Y-W, Chen Z-H, Luo J, Yin M-Y, Li L-L, Yang Y-D, et al. : Explore combined use of transcranial direct current stimulation and cognitive training on executive function after stroke. Journal of rehabilitation medicine 53(3):jrm00162 Pubmed Journal

548. Alashram AR, Annino G, Aldajah S, Raju M, Padua E : Rehabilitation of limb apraxia in patients following stroke: A systematic review. Applied neuropsychology. Adult 29(6):1658-1668 Pubmed Journal

549. Ji EK, Kwon JS : Effects of limb apraxia intervention in patients with stroke: A meta-analysis of randomized controlled trials. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association 32(2):106921 Pubmed Journal

550. Chen Z-J, Gu M-H, He C, Xiong C-H, Xu J, Huang X-L : Robot-Assisted Arm Training in Stroke Individuals With Unilateral Spatial

Neglect: A Pilot Study. Frontiers in neurology 12 691444 Pubmed Journal

551. Choi H-S, Shin W-S, Bang D-H : Application of digital practice to improve head movement, visual perception and activities of daily living for subacute stroke patients with unilateral spatial neglect: Preliminary results of a single-blinded, randomized controlled trial. Medicine 100(6):e24637 Pubmed Journal

552. Dido YM, Dulo OA : DYNAMIC OF UPPER LIMB SENSORIMOTOR RECOVERY ASSESSED ON THE FUGL-MEYER SCALE IN POST-STROKE PATIENTS WITH NEGLECT SYNDROME RECEIVING COMBINED PHYSICAL THERAPY AND ERGOTHERAPY. Wiadomosci lekarskie (Warsaw, Poland : 1960) 74(4):849-855 Pubmed

553. Fong KNK, Ting KH, Zhang X, Yau CSF, Li LSW : The Effect of Mirror Visual Feedback on Spatial Neglect for Patients after Stroke: A Preliminary Randomized Controlled Trial. Brain sciences 13(1): Pubmed Journal

554. Houben M, Chettouf S, Van Der Werf YD, Stins J : Theta-burst transcranial magnetic stimulation for the treatment of unilateral neglect in stroke patients: A systematic review and best evidence synthesis. Restorative neurology and neuroscience 39(6):447-465 Pubmed Journal

555. Longley V, Hazelton C, Heal C, Pollock A, Woodward-Nutt K, Mitchell C, et al. : Non-pharmacological interventions for spatial neglect or inattention following stroke and other non-progressive brain injury. The Cochrane database of systematic reviews 7(7):CD003586 Pubmed Journal

556. Li J, Li L, Yang Y, Chen S : Effects of Prism Adaptation for Unilateral Spatial Neglect After Stroke: A Systematic Review and Meta-Analysis. American journal of physical medicine & rehabilitation 100(6):584-591 Pubmed Journal

557. Meidian AC, Wahyuddin, Amimoto K : Rehabilitation interventions of unilateral spatial neglect based on the functional outcome measure: A systematic review and meta-analysis. Neuropsychological rehabilitation 32(5):764-793 Pubmed Journal

558. Park J-H : The effects of robot-assisted left-hand training on hemispatial neglect in older patients with chronic stroke: A pilot and randomized controlled trial. Medicine 100(9):e24781 Pubmed Journal

559. Qiu H, Wang J, Yi W, Yin Z, Wang H, Li J : Effects of Prism Adaptation on Unilateral Neglect After Stroke: An Updated Meta-Analysis of Randomized Controlled Trials. American journal of physical medicine & rehabilitation 100(3):259-265 Pubmed Journal

560. Sim TY, Kwon JS : Comparing the effectiveness of bimanual and unimanual mirror therapy in unilateral neglect after stroke: A pilot study. NeuroRehabilitation 50(1):133-141 Pubmed Journal

561. Zhang Y, Xing Y, Li C, Hua Y, Hu J, Wang Y, et al. : Mirror therapy for unilateral neglect after stroke: A systematic review. European journal of neurology 29(1):358-371 Pubmed Journal

562. Yang F-A, Lin C-L, Cho S-Y, Chou I-L, Han T-I, Yang P-Y : Short- and Long-Term Effects of Repetitive Transcranial Magnetic Stimulation on Poststroke Visuospatial Neglect: A Systematic Review and Meta-analysis of Randomized Controlled Trials. American journal of physical medicine & rehabilitation 102(6):522-532 Pubmed Journal

563. Zhao Y, Li W, Huang D, Zhang W, Zhang S, Liu Q, et al. : The therapeutic effect of transcranial direct current stimulation combined with cognitive training on patients with unilateral neglect after stroke. NeuroRehabilitation 52(3):477-483 Pubmed Journal