National Institute for Health and Care Excellence

Draft for consultation

Stroke rehabilitation in adults (update)

[J] Evidence reviews for computer-based tools for speech and language therapy

NICE guideline GID-NG10175

Evidence reviews underpinning recommendation 1.12.8 and research recommendations in the NICE guideline

April 2023

Draft for Consultation

These evidence reviews were developed by the Guideline Development Team at NICE

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1.1 Review question

In people with aphasia after stroke, what is the clinical and cost effectiveness of computer-based tools to augment speech and language therapy?

1.1.1 Introduction

Speech and language therapy after stroke is provided in hospitals and in the community to help people with resulting communication disorders to improve their speech/language impairment, their ability to communicate and participate in their everyday roles and activities. It is generally accepted that improvement requires practice, and that rehabilitation is more effective in higher doses. Providing therapy and practice opportunities in sufficient dose can be a challenge in clinical practice due to limitations on therapy resources and distance between patients and therapists in some community settings. In addition, people with communication needs often wish to continue to work on their speech/language for longer than therapy is available for and look for alternative ways to support them in doing this. A growing number of computer software programmes, apps and online therapy tools are commercially available (see aphasia therapy software finder https://www.aphasiasoftwarefinder.org). These tools are used by some therapists and patients to increase therapy practice opportunities either as home practice between therapy sessions or after face-to-face therapy has ended. Computer tools also offer a large range of practice material, practice material can be personalised, and some tools provide useful feedback.

This review has been prompted by publication of new evidence about effectiveness, and by an increasing interest in using computer tools to increase dose and to provide therapy remotely as was required during the COVID-19 pandemic.

1.1.2 Summary of the protocol

Table 1: PICO characteristics of review question

Population	Inclusion: • Adults (age ≥16 years) who have had a first or recurrent stroke (including people after subarachnoid haemorrhage) who have communication difficulties Exclusion: • Children (age <16 years) • People who had a transient ischaemic attack
Intervention	• Computer-based tools for speech and language therapy (to deliver therapy)
Comparisons	• Speech and language therapy without computer-based tools (usual care) • Social support/stimulation • No treatment • Placebo Confounding factors (for non-randomised studies only): • Severity of the communication disorder • Length of time post stroke

	• Age

Outcomes	All outcomes are considered equally important for decision making and therefore have all been rated as critical:
	At time period:
	• <3 months
	• ≥3 months
	
	• Person/participant generic health-related quality of life (continuous outcomes will be prioritised [validated measures])
	• Carer generic health-related quality of life (continuous outcomes will be prioritised [validated measures])
	• Communication (continuous outcomes will be prioritised)
	    o Overall language ability
	    o Impairment specific measures
	        – Naming
	        – Auditory comprehension
	        – Reading
	        – Expressive language
	        – Speech impairment (dysarthria)
	        – Activity (dysarthria)
	    o Functional communication
	• Communication related quality of life (continuous outcomes will be prioritised)
	• Psychological distress (continuous outcomes and aphasia specific measurement tools will be prioritised)
	    o Depression
	    o Anxiety
	    o Distress
	• Discontinuation (dichotomous outcome)

Study design	• Systematic reviews of RCTs
	• Parallel RCTs
	• Cluster randomised trials
	• Crossover studies (for people after chronic stroke only)
	• Non-randomised studies (if insufficient RCT evidence is available)
	    o Prospective cohort studies
	    o Retrospective cohort studies

For full details see the review protocol in Appendix A.

1.1.3 Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in appendix A and the methods document.

Declarations of interest were recorded according to NICE's conflicts of interest policy.

1.1.4 Effectiveness evidence

1.1.4.1 Included studies

21 randomised control trial studies (including 1 cross-over trial and 3 quasi-randomised trials) (27 papers) were included in the review;[5, 7-9, 12, 14, 18, 19, 22-27, 33, 37, 39, 42, 45, 47, 48] these are summarised in Table 2 below. Evidence from these studies is summarised in the clinical evidence summary below (Table 3).

3 quasi-randomised trials[7, 24, 47] were included. Due to the limited evidence investigating computer-based tools for speech and language therapy, it was agreed to include these studies but ensure that they were downgraded sufficiently for risk of bias due to the randomisation process. Evidence was available for all outcomes apart from carer generic health-related quality of life.

Population factors

The majority of studies included people with aphasia[5, 7-9, 12, 14, 18, 19, 22-25, 33, 39, 42, 47, 48]. However, studies occasionally included a mixture of people with aphasia or cognitive communication[26], mixture of people with aphasia or aphasia and apraxia of speech[37], people with dysarthria[27] or people with apraxia of speech[45]. Severity of communication difficulty was rarely reported, but when it was included people with mild communication difficulties[39] or with a mixture of different severities[37, 42]. Additionally, the majority of studies included people in the chronic phase after stroke[5, 7-9, 12, 14, 18, 24-26, 37, 39, 45, 47] with only occasional studies including people in the subacute phase or a mixture of people in the chronic and subacute phases[19, 22, 27, 33, 48]

Types of computer-based tools

The types of computer-based tools used varied between studies with no consistently used interventions. The method of therapy used varied including:

- Word finding therapy[5, 18, 37, 47]
- Reading therapy[7-9]
- Expressive language/communication[25, 45]
- Articulation therapy[27]
- Other (cognitive therapy)[22]
- Combinations of approaches[12, 14, 19, 23, 24, 26, 33, 39, 42, 48]

There was a mixture of therapies being delivered in person[7, 8, 12, 14, 19, 22, 39, 42], remotely[5, 9, 23-27, 33, 37, 45, 47, 48] (implementing telerehabilitation technology) or a combination of both [37].

Intensity of therapy

The therapies were delivered at a range of different intensities. Studies investigated the following total number of therapy hours:

- ≤10 hours[26, 45, 47]
- 11-20 hours[7, 12, 19, 22, 33]
- 21-30 hours[5, 8, 24, 25, 39, 48]
- ≥30 hours[9, 14, 18, 23, 42]
- Mixed (intensity could be varied)[27]
- Not stated/unclear[37]

Inconsistency

The majority of outcomes included only one study. However, occasionally meta-analysis was possible. Occasionally this would lead to heterogeneity. This could not be resolved by subgroup or sensitivity analysis, with the majority of outcomes containing an insufficient number of studies to allow valid conclusions on the analyses to be drawn. Therefore, outcomes were downgraded for inconsistency.

See also the study selection flow chart in Appendix C, study evidence tables in Appendix D, forest plots in Appendix E and GRADE tables in Appendix F.

1.1.4.2 Excluded studies

Two Cochrane reviews[4, 46] were identified and excluded from this review. For Brady 2016[4] this was due to the review including all speech and language therapy studies for people with aphasia, rather than just those that had computer-based tools being implemented. For West 2005[46] this included all speech and language therapy studies for people with apraxia of speech, rather than just those that had computer-based tools being implemented. In both cases, the citation lists of both studies were checked for relevant studies which were included if appropriate.

See the excluded studies list in Appendix J.

1.1.5 Summary of studies included in the effectiveness evidence

Table 2: Summary of studies included in the evidence review

Study	Intervention and comparison	Population	Outcomes	Comments
Braley 2021[5]	**Computer-based tools for speech and language therapy** (n=17) Computer-based tools for speech and language therapy (Constant Therapy app) for at least 30 minutes a day and at least 5 days a week. Total number of hours of therapy delivered using computer tools: 21-30 hours Remote delivery/in person delivery: Remote delivery Method of therapy: Word finding therapy **Speech and language therapy without computer-based tools (usual care)** (n=15) A regime of standard, paper workbooks used for homework practice: at least 1 exercise	**People after a first or recurrent stroke** Mean age (SD): 61.4 (10.3) years N = 32 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months)	Communication – Overall language ability at ≥3 months Communication related quality of life at ≥3 months	Setting: Home-based in the United States of America and Canada. Funding: Funded by The Learning Corp. The Learning Corp is now called Constant Therapy Health.

Study	Intervention and comparison	Population	Outcomes	Comments
	within the workbook at least 5 days a week. **Concomitant therapy:** No additional information.			
Caute 2019[7]	**Computer-based tools for speech and language therapy** (n=11) Computer based tools for speech and language therapy (Claro Software). 1-2 hours of technology set-up training, immediately followed by 12 one-hour therapy sessions delivered over 6 weeks (2 sessions per week). Total number of hours of therapy delivered using computer tools: 11-20 hours Remote delivery/in person delivery: In person delivery Method of therapy: Reading therapy **No treatment** (n=10) Waiting list control. **Concomitant therapy:** No additional information.	**People after a first or recurrent stroke** Mean age (SD): 55.8 (12.2) years N = 23 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥ 6 months)	Communication – Impairment specific measures (reading) at <3 months Functional communication at <3 months Communication related quality of life at <3 months Psychological distress – depression at <3 months Discontinuation at <3 months	Setting: Most people were treated in a University clinic, two were treated in their own home and one at a community centre in the United Kingdom. Funding: funded by The Barts Charity, Grantcode: MGU0243 awarded to Jane MArshall and Celia Woolf.
Cherney 2010[8]	**Computer-based tools for speech and language therapy** (n=11) ORLA treatment in the aphasia clinic, scheduled 2 to 3 times a week.	**People after a first or recurrent stroke** Mean age (SD): 59.1 (12.8) years N = 25	Communication – Overall language ability at ≥3 months Communication – Impairment specific measures	Setting: Outpatient follow up in the United States of America. Funding: Supported by grants H133G060055 and

Study	Intervention and comparison	Population	Outcomes	Comments
	Total number of hours of therapy delivered using computer tools: 21-30 hours Remote delivery/in person delivery: In person delivery Method of therapy: Word finding therapy **Speech and language therapy without computer-based tools (usual care)** (n=14) Same therapy delivered by a therapist instead. **Concomitant therapy**: No additional information.	Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥ 6 months)	(reading) at ≥3 months	H133G010098from the National Institute on Disability and Rehabilitation Research, US Department of Education.
Cherney 2021[9]	**Computer-based tools for speech and language therapy** (n=22) Web based ORLA (Oral Reading for Language in Aphasia). Practice 90 minutes/day, six days/week for six weeks. Concomitant therapy: No additional information. Total number of hours of therapy delivered using computer tools: ≥30 hours Remote delivery/in person delivery: Remote delivery Method of therapy: Reading therapy **Placebo** (n=13) Commercially available computer game.	**People after a first or recurrent stroke** Mean age (SD): intervention: 58.27(13.55), control: 55.19(11.46) years N = 35 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months)	Communication – Overall language ability at <3 months and ≥3 months Discontinuation at <3 months and ≥3 months	Setting: Free-standing urban rehabilitation hospital in the United States of America. Funding: Grant H133G06055 from the National Institute on Disability, Independent Living, and Rehabilitation Research.

Study	Intervention and comparison	Population	Outcomes	Comments
	Concomitant therapy: No additional information.			
De Luca 2018[12]	**Computer-based tools for speech and language therapy** (n=17) Power-Afa training 24 sessions of 45 minutes each,3 times a week for 8 weeks. Total number of hours of therapy delivered using computer tools: 11-20 hours Remote delivery/in person delivery: In person delivery Method of therapy: Combinations of the above **Speech and language therapy without computer-based tools (usual care)** (n=15) Traditional training only. **Concomitant therapy:** Traditional training available to all (standard cognitive rehabilitation for language disorders that was founded on cognitive neuropsychological approach to aphasia). 3 training sessions per week for 8 weeks (24 sessions of 45 minutes each).	**People after a first or recurrent stroke** Mean age (SD): 51.7 (14.8) years N = 32 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months)	Psychological distress – depression at <3 months and ≥3 months	Setting: Outpatient follow up in Italy. Funding: No additional information.
Elhakeem 2021[14]	**Computer-based tools for speech and language therapy** (n=25) The software Rawag (Arabic software program)	**People after a first or recurrent stroke** Mean age (SD): 57.9 (11.3) years N = 50	Communication – Overall language ability at ≥3 months Communication – Impairment specific measures	Setting: Outpatient follow up (in the Phoniatrics unit) in Egypt. Funding: This research did not

Study	Intervention and comparison	Population	Outcomes	Comments
	was delivered in therapy sessions with 2 sessions per week for 60 minutes a session with a total of 48 sessions over 6 months. Total number of hours of therapy delivered using computer tools: ≥30 hours Remote delivery/in person delivery: In person delivery Method of therapy: Combinations of the above **Speech and language therapy without computer-based tools (usual care)** (n=25) Conventional therapy provided for 2 sessions per week for 60 minutes with a total of 48 sessions over 6 months. **Concomitant therapy:** No additional information.	Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months) Majority Chronic (around 90%)	(naming) at ≥3 months Communication – Impairment specific measures (reading) at ≥3 months Communication – Impairment specific measures (auditory comprehension) at ≥3 months Communication – Impairment specific measures (expressive language) at ≥3 months Discontinuation at ≥3 months	receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.
Katz 1991[18]	**Computer-based tools for speech and language therapy** (n=10) Computer reading treatment. The computer reading treatment group used computers 3 hours each week to run visual-matching and reading comprehension software. Treatment was for 13 weeks (39 hours in total). Total number of hours of therapy delivered using	**People after a first or recurrent stroke** Mean age (SD): 62.8 (6.6) years N = 23 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months)	Communication – Overall language ability at ≥3 months	Setting: Outpatient follow up in the United States of America. Funding: supported in part by the Department of Veterans Affairs Rehabilitation Research and Development, Department of Medicine and Surgery.

Study	Intervention and comparison	Population	Outcomes	Comments
	computer tools: ≥30 hours Remote delivery/in person delivery: In person delivery Method of therapy: Word finding therapy **No treatment** (n=5) Received no computer reading treatment or stimulation **Placebo** (n=7) Computer stimulation. 3 hours computer use per week using cognitive rehabilitation software and computerized arcade-type games that did not include language stimuli. **Concomitant therapy:** No additional information.			
Kesav 2017[19]	**Computer-based tools for speech and language therapy** (n=12) 12 hours of addition supervised computer- based language rehabilitation therapy for 1 hour per session being delivered three times a week for 4 weeks. Total number of hours of therapy delivered using computer tools: 11-20 hours Remote delivery/in person delivery: In person delivery	**People after a first or recurrent stroke** Mean age (SD): 52.5 (12.3) years N = 24 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Subacute (7 days - 6 months)	Communication – Overall language ability at <3 months and ≥3 months Discontinuation at <3 months and ≥3 months	Setting: Tertiary health care institution outpatient follow-up in India. Funding: Centre for Disability Studies, Government of India (CeDS/FA/2011-2012).

Study	Intervention and comparison	Population	Outcomes	Comments
	Method of therapy: Combinations of the above **Speech and language therapy without computer-based tools (usual care)** (n=12) Conventional therapy only themed on the same premises only. **Concomitant therapy:** Speech and language therapist mediated conventional therapy for 12 hours with 1- hour sessions being delivered three times a week for 4 weeks.			
Liu 2021[22]	**Computer-based tools for speech and language therapy** (n=35) 30 minutes of speech and language therapy combined with computer-assisted executive control training for 30 minutes once a day, 6 days a week for up to 4 weeks. Total number of hours of therapy delivered using computer tools: 11-20 hours Remote delivery/in person delivery: In person delivery Method of therapy: Other cognitive therapy **Speech and language therapy without computer-**	**People after a first or recurrent stroke** Mean age (SD): 52.9 (14.1) years N = 70 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Subacute (7 days - 6 months)	Communication – Overall language ability at <3 months Communication – Impairment specific measures (naming) at <3 months Communication – Impairment specific measures (auditory comprehension) at <3 months Communication – Impairment specific measures (expressive language) at <3 months Discontinuation at <3 months	Setting: Outpatient follow up in China. Funding: The National Science Foundation of China (31871133), National Key Research and Development Programs (2020YFC2006604), and Xuzhou Science and Technology Project (KC17177).

Study	Intervention and comparison	Population	Outcomes	Comments
	based tools (usual care) (n=35) Speech and language therapy for 4 weeks. Routine language training for 30 minutes two times a day, 6 days a week for a total of 4 weeks. **Concomitant therapy:** Speech and language therapy was focused on training-specific deficits with corresponding training modules that covered auditory comprehension, repetition, reading, naming and writing.			
Maresca 2019[23]	**Computer-based tools for speech and language therapy** (n=15) Virtual reality rehabilitation system-tablet 5 days a week with each session lasting about 50 minutes. Total number of hours of therapy delivered using computer tools: ≥30 hours Remote delivery/in person delivery: Remote delivery Method of therapy: Combinations of the above **Speech and language therapy without computer-based tools (usual care)** (n=15) Traditional linguistic treatment with the same exercises as	**People after a first or recurrent stroke** Mean age (SD): 51.3 (11.6) years N = 30 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Not stated/unclear	Person/participant generic health-related quality of life at ≥3 months Communication – Impairment specific measures (auditory comprehension) at ≥3 months Psychological distress – depression at ≥3 months	Setting: Initially inpatient in Italy. Funding: No additional information.

Study	Intervention and comparison	Population	Outcomes	Comments
	the experimental linguistic therapy. The study lasted 6 months and included the two phases which lasted 12 weeks each. Training was completed 5 days a week with each session lasting about 50 minutes. **Concomitant therapy:** No additional information.			
Marshall 2016[24]	**Computer-based tools for speech and language therapy** (n=10) EVA Park intervention. Daily sessions with a support worker (25 sessions in total) each lasting about one hour, supplemented by unlimited independent access. Duration 7 weeks. Total number of hours of therapy delivered using computer tools: 21-30 hours Remote delivery/in person delivery: Remote delivery Method of therapy: Combinations of the above **No treatment** (n=10) Waitlist control group. **Concomitant therapy:** No additional information.	**People after a first or recurrent stroke** Mean age (SD): 57.8 (11.9) years N = 20 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months)	Communication – Impairment specific measures (naming) at <3 months Functional communication at <3 months Discontinuation at <3 months	Setting: Data were collected in the participants' homes or at City University London in the United Kingdom. Funding: No additional information.

Study	Intervention and comparison	Population	Outcomes	Comments
Marshall 2020[25]	**Computer-based tools for speech and language therapy** (n=16) EVA Park virtual reality group discussion sessions delivered as one and a half hour sessions with 14 sessions over 6 months. Total number of hours of therapy delivered using computer tools: 21-30 hours Remote delivery/in person delivery: Remote delivery Method of therapy: Expressive language/communication **No treatment** (n=18) Delayed treatment (treatment given after 6 months). **Concomitant therapy:** Usual care (not defined).	**People after a first or recurrent stroke** Median age (IQR): Computer-based tools: 51 (46.5-57.5) years No treatment: 65 (51.5-71.25) years N = 34 Type of communication difficulty: Aphasia. Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months)	Communication – Overall language ability at ≥3 months Communication - Functional communication at ≥3 months Communication related quality of life at ≥3 months Discontinuation at ≥3 months	Setting: Home-based (virtual reality) in the United Kingdom. Funding: Funded by The Stroke Association.
Meltzer 2018[26]	**Computer-based tools for speech and language therapy** (n=22) Weekly 1-hour sessions with the therapist over 10 weeks received in telerehabilitation conditions. Total number of hours of therapy delivered using computer tools: ≤10 hours Remote delivery/in person delivery: Remote delivery Method of therapy: Combinations of the above	**People after a first or recurrent stroke** Mean age (SD): 64.2 (11.1) years N = 44 Type of communication difficulty: Mixed. Aphasia or cognitive communication Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months)	Communication – Impairment specific measures (naming) at <3 months Communication – Impairment specific measures (auditory comprehension) at <3 months Communication – Impairment specific measures (expressive language) at <3 months	Setting: Outpatient setting in Canada. Funding: The project was supported by a "Telerehabilitation for Stroke" grant from the Heart and Stroke Foundation Canadian Partnership for Stroke Recovery. Matching funds were generously provided by the Manitoba Patient Access Network (MPAN).

Study	Intervention and comparison	Population	Outcomes	Comments
	Speech and language therapy without computer-based tools (usual care) (n=22) Same therapy principles but delivered in person. **Concomitant therapy:** No additional information.			
Mitchell 2018[27] Subsidiary study: Mitchell 2018[28]	**Computer-based tools for speech and language therapy** (n=26) ReaDySpeech, an online computer programme-expected to be over 8 to 10 weeks, although there was no specified intensity or duration. Total number of hours of therapy delivered using computer tools: Mixed. Intensity and duration could be varied. Remote delivery/in person delivery: Remote delivery Method of therapy: Articulation therapy **Speech and language therapy without computer-based tools (usual care)** (n=14) Usual care which would vary by site, from no intervention to best practice guidelines. **Concomitant therapy:** No additional information.	**People after a first or recurrent stroke** Mean age (range): Intervention: 70 (37 to 99) years. Control: 67 (55 to 85) years N = 40 Type of communication difficulty: Dysarthria Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Subacute (7 days - 6 months)	Communication – Impairment specific measures (speech impairment – dysarthria) at <3 months Communication – Impairment specific measures (activity – dysarthria) at <3 months Communication related quality of life at <3 months Discontinuation at <3 months	Setting: Hospital and community-based stroke services in the United Kingdom. Funding: funded by the NIHR Doctoral Training Program (project no. DRF-2014-07-043).

Study	Intervention and comparison	Population	Outcomes	Comments
Ora 2020[33] Subsidiary study: Ora 2018[34]	**Computer-based tools for speech and language therapy** (n=32) 16 sessions of speech-language therapy via videoconference over 32 days. Average 18.6 (1.5) hours. Total number of hours of therapy delivered using computer tools: 11-20 hours Remote delivery/in person delivery: Remote delivery Method of therapy: Combinations of the above **Speech and language therapy without computer-based tools (usual care)** (n=30) Usual care only. AND/OR **Concomitant therapy:** All people received usual care from local speech-language pathologists at the community level and/or in a rehabilitation institution. The dosage was measured by hours from inclusion to follow-up assessment. On average usual care was completed for 20.4 (12.0) hours and 25.0 (13.8) hours for the intervention and control group respectively.	**People after a first or recurrent stroke** Mean age (SD): 64.9 (12.0) years N = 62 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Mixed	Communication – Impairment specific measures (naming) at <3 months and ≥3 months Communication – Impairment specific measures (auditory comprehension) at <3 months and ≥3 months Discontinuation at <3 months and ≥3 months	Setting: Outpatient follow up in Norway. Funding: Funded by the South-Eastern Norway Regional Health Authority (project number 2015037) and has also received financial support from the University of Oslo and Sunnaas Rehabilitation Hospital. The NMAHP RU and MB is supported by the Chief Scientist Office, part of the Scottish Government Health and Social Care Directorates.

Study	Intervention and comparison	Population	Outcomes	Comments
Palmer 2019[37] Subsidiary studies: Palmer 2015[36] Palmer 2020[38] Latimer 2021[20]	**Computer-based tools for speech and language therapy** (n=97) Daily, self-managed, word-finding exercises on a computer at home, which were tailored to the needs of the individual patient by a speech and language therapist. Duration 6 months. Total number of hours of therapy delivered using computer tools: Not stated/unclear Remote delivery/in person delivery: Mixed Method of therapy: Word finding therapy **Speech and language therapy without computer-based tools (usual care)** (n=101) Usual care only **Social support/stimulation** (n=80) Paper-based puzzle book activities on a daily basis and received supportive telephone calls from the research team once a month. **Concomitant therapy:** All people received usual care. Usual care constituted speech and language therapy amount recorded for 3 months before people who had	**People after a first or recurrent stroke** Mean age (SD): 65.3 (13.0) years N = 278 Type of communication difficulty: Mixed. All had aphasia. Around 35% had apraxia of speech. Severity of communication difficulty: Mixed Time after stroke at the start of the trial: Chronic (≥6 months)	Person/participant generic health-related quality of life at ≥3 months Communication – Impairment specific measures (naming) at ≥3 months Functional communication at ≥3 months Communication related quality of life at ≥3 months Discontinuation at ≥3 months	Big CACTUS trial. Setting: Outpatient at speech and language therapy departments in the United Kingdom. Funding: National Institute for Health Research, Tavistock Trust for Aphasia.

Study	Intervention and comparison	Population	Outcomes	Comments
	chronic aphasia longer than 4 months after stroke were randomised.			
Palmer 2012[39] Subsidiary study: Latimer 2013[21]	**Computer-based tools for speech and language therapy** (n=17) StepbyStep computer program in addition to usual language activities for at least 20 minutes, 3 days a week for 5 months (approximately 1500 minutes of practice time in total). Total number of hours of therapy delivered using computer tools: 21-30 hours Remote delivery/in person delivery: In person delivery Method of therapy: Combinations of the above. Word finding and reading **Speech and language therapy without computer-based tools (usual care)** (n=17) Usual care only. **Concomitant therapy:** All people participated in activities that provide general language stimulation as they had done previously including attendance at communication support groups and conversation, reading and writing activities that were a part of everyday life.	**People after a first or recurrent stroke** Mean age (SD): 67.9 (12.4) years N = 34 Type of communication difficulty: Aphasia but may have also had dyspraxia Severity of communication difficulty: Mild. Mixed but majority mild Time after stroke at the start of the trial: Chronic (≥6 months)	Communication – Impairment specific measures (naming) at ≥3 months Discontinuation at ≥3 months	CACTUS trial. Setting: Outpatient follow up in the United Kingdom. Funding: Independent research commissioned by the National Institute for Health Research (NIHR) under its Research for Patient Benefit (RfPB) Programme (Grant Reference Number PB-PG-1207-14097). This study was also supported by the Stroke and Telehealth themes of the South Yorkshire Collaboration for Leadership in applied health research and care (CLAHRC). NIHRCLAHRC) for South Yorkshire acknowledges funding from the National Institute of Health Research. The study also received support from the North of Tyne Primary Care Trust.

Study	Intervention and comparison	Population	Outcomes	Comments
Spaccavento 2021[42]	**Computer-based tools for speech and language therapy** (n=13) One, 50 minute session for 5 days per week over a period of 8 weeks. Total number of hours of therapy delivered using computer tools: ≥30 hours Remote delivery/in person delivery: In person delivery Method of therapy: Combinations of the above **Speech and language therapy without computer-based tools (usual care)** (n=9) Therapist-mediated aphasia treatment. One, 50 minute session for 5 days per week over a period of 8 weeks. **Concomitant therapy:** No additional information (all people were provided the same amount of therapy).	**People after a first or recurrent stroke** Mean age (SD): 60.1 (12.4) years N = 22 Type of communication difficulty: Aphasia Severity of communication difficulty: Mixed. Moderate to severe Time after stroke at the start of the trial: Subacute (7 days - 6 months)	Communication – Impairment specific measures (naming) at <3 months Communication – Impairment specific measures (auditory comprehension) at <3 months Communication – Impairment specific measures (reading) at <3 months Communication – Impairment specific measures (expressive language) at <3 months Functional communication at <3 months Communication related quality of life at <3 months	Setting: Inpatient in Italy. Funding: No sponsors. No financial or personal relationships with other people or organisations that could inappropriately influence their work.
Varley 2016[45]	**Computer-based tools for speech and language therapy** (n=50) Therapy was delivered for 6 weeks. Regular use of the software was encouraged (once or twice a day for at least 20 minutes). Total number of hours of therapy delivered using computer tools: ≤10 hours	**People after a first or recurrent stroke** Age range: Intervention: 28 to 91 years Control: 36 to 86 N = 50 (in the trial in total - 25 in each arm during the randomisation process) Type of communication difficulty: Apraxia of speech	Communication – Impairment specific measures (naming) at <3 months	Setting: Community speech and language therapy services in the United Kingdom. Funding: Bupa UK Foundation specialist grant programme. Washout period of 4 weeks separating the two 6-week treatment periods.

Study	Intervention and comparison	Population	Outcomes	Comments
	Remote delivery/in person delivery: Remote delivery Method of therapy: Expressive language/communi cation **Placebo** (n=50) Sham therapy using visuospatial sham program. No speech and language component. Regular use of the software was encouraged (once or twice a day for at least 20 minutes). **Concomitant therapy:** No additional information	Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months)		
Woolf 2016[47]	**Computer-based tools for speech and language therapy** (n=10) Eight sessions of word finding therapy, delivered remotely, twice a week or 4 weeks. Total number of hours of therapy delivered using computer tools: ≤10 hours Remote delivery/in person delivery: Remote delivery Method of therapy: Word finding therapy **Speech and language therapy without computer-based tools (usual care)** (n=5) Face-to-face sessions of word finding therapy. The same procedure as the	**People after a first or recurrent stroke** Mean age (SD): 59.2 (13.8) years N = 20 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Chronic (≥6 months)	Communication – Impairment specific measures (naming) at <3 months and ≥3 months Discontinuation at <3 months and ≥3 months	Setting: A University lab and NHS outpatient service in the United Kingdom. Funding: supported by the Tavistock Trust for Aphasia, the Charles Wolfson Charitable Trust and the Bupa Foundation (grant number: TBF-PPW 11-017F).

Study	Intervention and comparison	Population	Outcomes	Comments
	computer-based tools group but delivered face to face. **Social support/stimulation** (n=5) Attention control condition where 8 remote conversation sessions were received. Sessions were scheduled twice a week (8 hours in total). **Concomitant therapy:** All people were provided with a workbook, comprising pictures of their target words. Each person worked on 50 words, with each word targeted at least once per session.			
Zhou 2018[48]	**Computer-based tools for speech and language therapy** (n=20) Telerehabilitation training program. The inpatient group received just computerized speech and language therapy while the outpatient group received computerized speech-language therapy for 30 minutes a day in addition to 30 minutes a day of family topics communication for 30. Training was 30 minutes a session, 2 times a day for 30 days.	**People after a first or recurrent stroke** Mean age (SD): 57.8 (13.9) years N = 40 Type of communication difficulty: Aphasia Severity of communication difficulty: Not stated/unclear Time after stroke at the start of the trial: Subacute (7 days - 6 months)	Communication – Overall language ability at <3 months Communication – Impairment specific measures (naming) at <3 months Communication – Impairment specific measures (auditory comprehension) at <3 months Functional communication at <3 months	Setting: Inpatients and outpatients in Italy. Funding: supported by grants from the Natural Science Foundation of China (NSFC 31571156, 31871133) and grants from Jiangsu Province (BRA2017392, 2017-JY-025, H201670 and KYLX16-1302).

Study	Intervention and comparison	Population	Outcomes	Comments
	Total number of hours of therapy delivered using computer tools: 21-30 hours Remote delivery/in person delivery: Remote delivery Method of therapy: Combinations of the above **Speech and language therapy without computer-based tools (usual care)** (n=20) The inpatient group received routine therapy twice a day for 30 minutes a session. The outpatient group received family topics communication for 30 minutes a session, 2 times a day for 30 days. **Concomitant therapy:** No additional information.			

1 See Appendix D for full evidence tables.

1.1.5.1 Summary matrix

Table 3: Summary matrix of computer-based tools for speech and language therapy compared to each comparison groups

Outcome	Time point	Computer-based tools compared to speech and language therapy without computer-based tools	Computer-based tools compared to social support/stimulation	Computer-based tools compared to no treatment	Computer-based tools compared to placebo
Person/participant generic health-related quality of life	<3 months	No evidence identified.	No evidence identified.	No evidence identified.	No evidence identified.
	≥3 months	2 outcomes 2 studies (n=228) Moderate-low quality	No evidence identified.	No evidence identified.	
Carer generic health-related quality of life	<3 months	No evidence identified.	No evidence identified.	No evidence identified.	No evidence identified.
	≥3 months	No evidence identified.	No evidence identified.	No evidence identified.	No evidence identified.
Communication – Overall language ability	<3 months	1 outcome 3 studies (n=128) Very low quality	No evidence identified.	1 outcome 1 study (n=15) Low quality	1 outcome 1 study (n=32) Low quality
	≥3 months	2 outcomes 4 studies (n=127) Low quality	No evidence identified.	No evidence identified.	1 outcome 2 studies (n=46) Very low quality
Communication – Impairment specific measures (naming)	<3 months	2 outcomes 6 studies (n=251) Low-very low quality	1 outcome 1 study (n=15) Low quality	1 outcome 1 study (n=20) Very low quality	1 outcome 1 study (n=100) Low quality
	≥3 months	3 outcomes 5 studies (n=341) Moderate-low quality	1 outcome 2 studies (n=188) Very low quality	No evidence identified.	No evidence identified.
Communication – Impairment specific	<3 months	2 outcomes 5 studies (n=236)	No evidence identified.	No evidence identified.	No evidence identified.

Outcome	Time point	Computer-based tools compared to speech and language therapy without computer-based tools	Computer-based tools compared to social support/stimulation	Computer-based tools compared to no treatment	Computer-based tools compared to placebo
measures (auditory comprehension)		High-low quality			
	≥3 months	5 outcomes 3 studies (n=142) High-Low quality	No evidence identified.	No evidence identified.	No evidence identified.
Communication – Impairment specific measures (reading)	<3 months	1 outcome 1 study (n=22) Low quality	No evidence identified.	No evidence identified.	No evidence identified.
	≥3 months	3 outcomes 2 studies (n=75) High to very low quality	No evidence identified.	No evidence identified.	No evidence identified.
Communication – Impairment specific measures (expressive language)	<3 months	2 outcomes 3 studies (n=134) Very low quality	No evidence identified.	1 outcome 1 study (n=31) Very low quality	No evidence identified.
	≥3 months	6 outcomes 1 study (n=50) Moderate quality	No evidence identified.	No evidence identified.	No evidence identified.
Communication – Impairment specific measures (speech impairment – Dysarthria)	<3 months	1 outcome 1 study (n=37) Very low quality	No evidence identified.	No evidence identified.	No evidence identified.
	≥3 months	No evidence identified.	No evidence identified.	No evidence identified.	No evidence identified.
Communication – Impairment specific measures (Activity – Dysarthria)	<3 months	1 outcome 1 study (n=37) Very low quality	No evidence identified.	No evidence identified.	No evidence identified.
	≥3 months	No evidence identified.	No evidence identified.	No evidence identified.	No evidence identified.

Outcome	Time point	Computer-based tools compared to speech and language therapy without computer-based tools	Computer-based tools compared to social support/stimulation	Computer-based tools compared to no treatment	Computer-based tools compared to placebo
Communication – Functional communication	<3 months	1 outcome 2 studies (n=62) Very low quality	No evidence identified.	1 outcome 2 studies (n=41) Very low quality	No evidence identified.
	≥3 months	1 outcome 1 study (n=191) High quality	1 outcome 1 study (n=173) High quality	No evidence identified.	No evidence identified.
Communication related quality of life	<3 months	1 outcome 2 studies (n=59) Very low quality	No evidence identified.	1 outcome 1 study (n=21) Very low quality	No evidence identified.
	≥3 months	1 outcome 2 studies (n=221) High quality	1 outcome 1 study (n=174) High quality	No evidence identified.	No evidence identified.
Psychological distress – depression	<3 months	1 outcome 1 study (n=32) Very low quality	No evidence identified.	1 outcome 1 study (n=21) Very low quality	No evidence identified.
	≥3 months	1 outcome 2 studies (n=62) Moderate quality	No evidence identified.	No evidence identified.	No evidence identified.
Psychological distress – anxiety	<3 months	No evidence identified.	No evidence identified.	No evidence identified.	No evidence identified.
	≥3 months	No evidence identified.	No evidence identified.	No evidence identified.	No evidence identified.
Psychological distress – distress	<3 months	No evidence identified.	No evidence identified.	No evidence identified.	No evidence identified.
	≥3 months	No evidence identified.	No evidence identified.	No evidence identified.	No evidence identified.

Outcome	Time point	Computer-based tools compared to speech and language therapy without computer-based tools	Computer-based tools compared to social support/stimulation	Computer-based tools compared to no treatment	Computer-based tools compared to placebo
Discontinuation	<3 months	1 outcome 5 studies (n=211) Very low quality	1 outcome 1 study (n=15) Very low quality	1 outcome 2 studies (n=41) Very low quality	1 outcome 1 study (n=32) Very low quality
	≥3 months	1 outcome 6 studies (n=383) Very low quality	1 outcome 2 studies (n=192) Very low quality	No evidence identified.	1 outcome 1 study (n=32) Very low quality

1.1.6 Summary of the effectiveness evidence

Table 4: Clinical evidence summary: computer-based tools for speech and language therapy compared to speech and language therapy without computer-based tools (usual care)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
Person/participant generic health-related quality of life (EuroQol-5D, 0-100, higher values are better, change score) at ≥3 months	30 (1 RCT) follow-up: 6 months	⊕⊕◯◯ Low[a]	-	The mean person/participant generic health-related quality of life at ≥3 months was 8.7	MD **13.3 higher** (9.23 higher to 17.37 higher)	MID = 3.78 (0.5 x median control group SD)
Person/participant generic health-related quality of life (EQ-5D-5L, -0.11-1, higher values are better, final value) at ≥3 months	198 (1 RCT) follow-up: 12 months	⊕⊕⊕◯ Moderate[b]	-	The mean person/participant generic health-related quality of life at ≥3 months was 0.65	MD **0.06 lower** (0.13 lower to 0.01 higher)	MID = 0.03 (EQ-5D established MID)
Communication - overall language ability (Western Aphasia Battery Aphasia Quotient, 0-100, higher values are better, change score and final values) at <3 months	160 (3 RCTs) follow-up: mean 4 weeks	⊕◯◯◯ Very low[a,b,c]	-	The mean communication - overall language ability at <3 months was 40.9	MD **11.91 higher** (7.79 higher to 16.03 higher)	MID = 13.9 (0.5 x median baseline SD)
Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change scores and final value) at ≥3 months	77 (3 RCTs) follow-up: mean 3 months	⊕⊕◯◯ Low[a]	-	The mean communication - overall language ability at ≥3 months was 24.7	MD **4.94 higher** (2.09 higher to 7.78 higher)	MID = 12.5 (0.5 x median baseline SD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
Communication - overall language ability (Aphasia severity rating scale, 0-5, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕◯◯ Low[b]	-	The mean communication - overall language ability at ≥3 months was 2.44	MD **0.04 higher** (0.43 lower to 0.51 higher)	MID = 0.34 (0.5 x median baseline SD)
Communication - impairment specific measures (naming) (Western Aphasia Battery oral naming, scale range unclear, higher values are better, change score) at <3 months	68 (1 RCT) follow-up: 4 weeks	⊕◯◯◯ Very low[b,d]	-	The mean communication - impairment specific measures (naming) at <3 months was 0.37	MD **0.89 higher** (0.39 lower to 2.17 higher)	MID = 0.87 (0.5 x median baseline SD)
Communication - impairment specific measures (naming) (Western Aphasia Battery naming and word finding subscale, NGA subscale naming, AAT naming subtest, naming assessment [different scale ranges], higher values are better, final values) at <3 months	183 (5 RCTs) follow-up: mean 7 weeks	⊕⊕◯◯ Low[a]	-	-	SMD **0.12 SD lower** (0.41 lower to 0.18 higher)	MID = 0.5 SD (SMD)
Communication - impairment specific measures (naming) (Boston Naming Test, items, higher values are better,	50 (1 RCT) follow-up: 6 months	⊕⊕⊕◯ Moderate[b]	-	The mean communication - impairment specific measures (naming) at ≥3 months was 37.08	MD **9.96 higher** (3.75 higher to 16.17 higher)	MID = 3.9 (0.5 x median baseline SD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
change score) at ≥3 months						
Communication - impairment specific measures (naming) (words named correctly, word finding ability, %, higher values are better, change scores) at ≥3 months	215 (2 RCTs) follow-up: mean 10 months	⊕⊕⊕◯ Moderate[b]	-	The mean communication - impairment specific measures (naming) at ≥3 months was 8.1	MD **10.82 higher** (6.21 higher to 15.42 higher)	MID = 9.3 (0.5 x median baseline SD)
Communication - impairment specific measures (naming) (NGA subtest naming, Naming Assessment, 0-100, higher values are better, final values) at ≥3 months	76 (2 RCTs) follow-up: mean 4 months	⊕⊕◯◯ Low[b]	-	The mean communication - impairment specific measures (naming) at ≥3 months was 46.8	MD **3.08 lower** (13.38 lower to 7.23 higher)	MID = 4.8 (0.5 x median baseline SD)
Communication - impairment specific measures (auditory comprehension) (Western Aphasia Battery auditory comprehension, scale range unclear, higher values are better, change score) at <3 months	68 (1 RCT) follow-up: 4 weeks	⊕⊕◯◯ Low[d]	-	The mean communication - impairment specific measures (auditory comprehension) at <3 months was 2.44	MD **0.13 lower** (0.66 lower to 0.4 higher)	MID = 1.34 (0.5 x median baseline SD)
Communication - impairment specific measures (auditory comprehension) (Western Aphasia Battery comprehension	168 (4 RCTs) follow-up: mean 7 weeks	⊕⊕⊕⊕ High	-	-	SMD **0.02 SD lower** (0.33 lower to 0.28 higher)	MID = 0.5 SD (SMD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
subtest, NGA comprehension subtest, AAT token subtest [different scale ranges], higher values are better, final values) at <3 months						
Communication - impairment specific measures (auditory comprehension) (Token test, 0-36, higher values are better, change score) at ≥3 months	30 (1 RCT) follow-up: 6 months	⊕⊕◯◯ Low[a]	-	The mean communication - impairment specific measures (auditory comprehension) at ≥3 months was -2	MD **5.3 lower** (6.94 lower to 3.66 lower)	MID = 1.4 (0.5 x median control group SD)
Communication - impairment specific measures (auditory comprehension) (BDAE complex ideational material subtest, 0-10, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕⊕ High	-	The mean communication - impairment specific measures (auditory comprehension) at ≥3 months was 4.4	MD **0.2 higher** (1.27 lower to 1.67 higher)	MID = 2.1 (0.5 x median baseline SD)
Communication - impairment specific measures (auditory comprehension) (BDAE commands subtest, 0-24, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕⊕ High	-	The mean communication - impairment specific measures (auditory comprehension) at ≥3 months was 4.8	MD **0.08 higher** (2 lower to 2.16 higher)	MID = 2.9 (0.5 x median baseline SD)
Communication - impairment specific	50 (1 RCT)	⊕⊕⊕⊕ High	-	The mean communication - impairment	MD **0.2 higher** (4.72	MID = 6.9 (0.5 x median

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
measures (auditory comprehension) (BDAE basic word discrimination subtest, 0-72, higher values are better, change score) at ≥3 months	follow-up: 6 months			specific measures (auditory comprehension) at ≥3 months was 10.36	lower to 5.12 higher)	baseline SD)
Communication - impairment specific measures (auditory comprehension) (NGA subtest comprehension, 0-100, higher values are better, final value) at ≥3 months	62 (1 RCT) follow-up: 4 months	⊕⊕◯◯ Low[b]	-	The mean communication - impairment specific measures (auditory comprehension) at ≥3 months was 61.5	MD **0.5 lower** (13.94 lower to 12.94 higher)	MID = 11.0 (0.5 x median baseline SD)
Communication - impairment specific measures (reading) (Functional Assessment Measure Reading, 0-7, higher values are better, final value) at <3 months	22 (1 RCT) follow-up: 8 weeks	⊕⊕◯◯ Low[b]	-	The mean communication - impairment specific measures (reading) at <3 months was 3.78	MD **0.05 higher** (1.12 lower to 1.22 higher)	MID = 0.86 (0.5 x median baseline SD)
Communication - impairment specific measures (reading) (Western Aphasia Battery reading, 0-100, higher values are better, change score) at ≥3 months	25 (1 RCT) follow-up: 3 months	⊕◯◯◯ Very low[b,d]	-	The mean communication - impairment specific measures (reading) at ≥3 months was 1.36	MD **4.91 lower** (15.18 lower to 5.36 higher)	MID = 12.8 (0.5 x median baseline SD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
Communication - impairment specific measures (reading) (BDAE basic oral reading subtest, 0-30, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕⊕ High	-	The mean communication - impairment specific measures (reading) at ≥3 months was 10.21	MD **0.09 higher** (3.12 lower to 3.3 higher)	MID = 3.5 (0.5 x median baseline SD)
Communication - impairment specific measures (reading) (BDAE oral reading of sentences with comprehension, 0-10, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕⊕ High	-	The mean communication - impairment specific measures (reading) at ≥3 months was 4.53	MD **0.07 higher** (0.98 lower to 1.12 higher)	MID = 1.4 (0.5 x median baseline SD)
Communication - impairment specific measures (expressive language) (Western Aphasia Battery Spontaneous speech, scale range unclear, higher values are better, change score) at <3 months	68 (1 RCT) follow-up: 4 weeks	⊕◯◯◯ Very low[b,d]	-	The mean communication - impairment specific measures (expressive language) at <3 months was 1.4	MD **1.73 higher** (0.48 higher to 2.98 higher)	MID = 2.5 (0.5 x median baseline SD)
Communication - impairment specific measures (expressive language) (Western Aphasia Battery Spontaneous speech, Functional	66 (2 RCTs) follow-up: mean 9 weeks	⊕◯◯◯ Very low[b,e]	-	-	SMD **0.12 SD lower** (0.61 lower to 0.36 higher)	MID = 0.5 SD (SMD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
Assessment Measure Expression, [different scale ranges], higher values are better, final values) at <3 months						
Communication - impairment specific measures (expressive language) (BDAE articulatory agility subtest, 1-7, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕◯ Moderate [b]	-	The mean communication - impairment specific measures (expressive language) at ≥3 months was 1.04	MD **0.2 higher** (0.34 lower to 0.74 higher)	MID = 0.67 (0.5 x median baseline SD)
Communication - impairment specific measures (expressive language) (BDAE grammatical forms subtest, 1-7, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕◯ Moderate [b]	-	The mean communication - impairment specific measures (expressive language) at ≥3 months was 2.4	MD **0.48 higher** (0.13 lower to 1.09 higher)	MID = 0.29 (0.5 x median baseline SD)
Communication - impairment specific measures (expressive language) (BDAE melodic line subtest, 1-7, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕◯ Moderate [b]	-	The mean communication - impairment specific measures (expressive language) at ≥3 months was 2.04	MD **1 higher** (0.41 higher to 1.59 higher)	MID = 0.48 (0.5 x median baseline SD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
Communication - impairment specific measures (expressive language) (BDAE paraphrasia subtest, 1-7, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕◯ Moderate [b]	-	The mean communication - impairment specific measures (expressive language) at ≥3 months was 2.28	MD **1.64 higher** (0.46 higher to 2.82 higher)	MID = 1.1 (0.5 x median baseline SD)
Communication - impairment specific measures (expressive language) (BDAE phrase length subtest, 1-7, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕◯ Moderate [b]	-	The mean communication - impairment specific measures (expressive language) at ≥3 months was 2.12	MD **0.68 higher** (0.12 higher to 1.24 higher)	MID = 0.48 (0.5 x median baseline SD)
Communication - impairment specific measures (expressive language) (BDAE word-finding relative to fluency subtest, 1-7, higher values are better, change score) at ≥3 months	50 (1 RCT) follow-up: 6 months	⊕⊕⊕◯ Moderate [b]	-	The mean communication - impairment specific measures (expressive language) at ≥3 months was 0.48	MD **0.8 higher** (0 to 1.6 higher)	MID = 0.57 (0.5 x median baseline SD)
Communication - impairment specific measures (dysarthria - speech impairment) (Frenchay Dysarthria Assessment-II, unclear scale	37 (1 RCT) follow-up: 10 weeks	⊕◯◯◯ Very low[b,f]	-	The mean communication - impairment specific measures (dysarthria - speech impairment) at <3 months was 184	MD **7 lower** (26.05 lower to 12.05 higher)	MID = 15.9 (0.5 x median baseline SD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
range, higher values are better, final value) at <3 months						
Communication - impairment specific measures (dysarthria - activity) (Dysarthria Therapy Outcome Measures, unclear scale range, higher values are better, final value) at <3 months	37 (1 RCT) follow-up: 10 weeks	⊕◯◯◯ Very low[b,f]	-	The mean communication - impairment specific measures (dysarthria - activity) at <3 months was 3.9	MD **0.3 lower** (0.85 lower to 0.25 higher)	MID = 0.48 (0.5 x median baseline SD)
Communication - functional communication (Communication activities of daily living, functional outcome questionnaire aphasia total score [different scale ranges], higher values are better, final values) at <3 months	62 (2 RCTs) follow-up: mean 6 weeks	⊕◯◯◯ Very low[a,b]	-	-	SMD **0.02 SD lower** (0.52 lower to 0.48 higher)	MID = 0.5 SD (SMD)
Communication - functional communication (TOMS, 0-10, higher values are better, change score) at ≥3 months	191 (1 RCT) follow-up: 12 months	⊕⊕⊕⊕ High	-	The mean communication - functional communication at ≥3 months was 0.13	MD **0.01 lower** (0.23 lower to 0.21 higher)	MID = 0.55 (0.5 x median baseline SD)
Communication related quality of life (COAST, Quality of Life Questionnaire for Aphasics Total score [different	59 (2 RCTs) follow-up: mean 9 weeks	⊕◯◯◯ Very low[b,g]	-	-	SMD **0.34 SD lower** (0.87 lower to 0.18 higher)	MID = 0.5 SD (SMD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
scale ranges], higher values are better, final values) at <3 months						
Communication related quality of life (Stroke and Aphasia Quality of Life Scale-39, COAST [different scale ranges], higher values are better, change scores) at ≥3 months	221 (2 RCTs) follow-up: mean 8 months	⊕⊕⊕⊕ High	-	-	SMD **0.09 SD lower** (0.35 lower to 0.18 higher)	MID = 0.5 SD (SMD)
Psychological distress - depression (Aphasic Depression Rating Scale, scale range unclear, higher values are better, final value) at <3 months	32 (1 RCT) follow-up: 8 weeks	⊕◯◯◯ Very low[b,h]	-	The mean psychological distress - depression at <3 months was 0.5	MD **4.9 higher** (3.08 higher to 6.72 higher)	MID = 3.2 (0.5 x median baseline SD)
Psychological distress - depression (Aphasic Depression Rating Scale, unclear scale range, higher values are better, change scores) at ≥3 months	62 (2 RCTs) follow-up: mean 6 months	⊕⊕⊕◯ Moderate[b]	-	The mean psychological distress - depression at ≥3 months was 1.1	MD **4.54 higher** (3.18 higher to 5.89 higher)	MID = 3.2 (0.5 x median baseline SD)
Discontinuation at <3 months	211 (5 RCTs) follow-up: mean 6 weeks	⊕◯◯◯ Very low[a,b,i]	RD 0.06 (-0.09 to 0.20)	63 per 1,000	**59 fewer per 1,000** (68 fewer to 50 fewer)[j]	Precision calculated through Optimal Information Size (OIS) due to zero events in some studies.

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	
						OIS determined power for the sample size = 0.71 (0.8-0.9 = serious, <0.8 = very serious).
Discontinuation at ≥3 months	383 (6 RCTs) follow-up: mean 6 months	⊕◯◯◯ Very low[b,i]	RD 0.01 (-0.06 to 0.09)	158 per 1,000	**156 fewer per 1,000** (167 fewer to 144 fewer)[j]	Precision calculated through Optimal Information Size (OIS) due to zero events in some studies. OIS determined power for the sample size = 0.06 (0.8-0.9 = serious, <0.8 = very serious).

a. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in measurement of the outcome)

b. Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs

c. Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis

d. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions and bias in measurement of the outcome)

e. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions and bias due to missing outcome data)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with speech and language therapy without computer-based tools (usual care)	Risk difference with Computer-based tools for speech and language therapy	

f. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias due to deviations from the intended interventions and bias due to missing outcome data)

g. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias due to deviations from the intended interventions and bias due to missing outcome data)

h. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in selection of the reported result)

i. Downgraded for heterogeneity due to conflicting number of events in different studies (zero events in one or more studies)

j. Absolute effect calculated by risk difference due to zero events in at least one arm of one study

Table 5: Clinical evidence summary: computer-based tools for speech and language therapy compared to social support/stimulation

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with social support/stimulation	Risk difference with Computer-based tools for speech and language therapy	
Person/participant generic health-related quality of life (EQ-5D-5L, -0.11-1, higher values are better, final value) at ≥3 months	177 (1 RCT) follow-up: 12 months	⊕⊕◯◯ Low[a]	-	The mean person/participant generic health-related quality of life at ≥3 months was 0.59	MD **0** (0.07 lower to 0.07 higher)	MID = 0.03 (EQ-5D established MID)
Communication - impairment specific measures (naming) (naming assessment, 0-100, higher values are	15 (1 RCT) follow-up: 8 weeks	⊕⊕◯◯ Low[b]	-	The mean communication - impairment specific measures (naming) at <3 months was 9.6	MD **29 higher** (14.38 higher to 43.62 higher)	MID = 4.1 (0.5 x median baseline SD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with social support/stimulation	Risk difference with Computer-based tools for speech and language therapy	
better, final value) at <3 months						
Communication - impairment specific measures (naming) (word finding ability, naming assessment, 0-100/%, higher values are better, change score and final value) at ≥3 months	188 (2 RCTs) follow-up: mean 8 months	⊕◯◯◯ Very low[a,c]	-	The mean communication - impairment specific measures (naming) at ≥3 months was 8.75	MD **16.96 higher** (2.52 lower to 36.44 higher)	MID = 7.4 (0.5 x median baseline SD)
Communication - functional communication (TOMS, 0-10, higher values are better, change score) at ≥3 months	173 (1 RCT) follow-up: 12 months	⊕⊕⊕⊕ High	-	The mean communication - functional communication at ≥3 months was 0.09	MD **0.03 higher** (0.22 lower to 0.28 higher)	MID = 0.55 (0.5 x median baseline SD)
Communication related quality of life (COAST, %, higher values are better, change score) at ≥3 months	173 (1 RCT) follow-up: 12 months	⊕⊕⊕⊕ High	-	The mean communication related quality of life at ≥3 months was 3.4	MD **1.9 higher** (2.31 lower to 6.11 higher)	MID = 6.85 (0.5 x median baseline SD)
Discontinuation at <3 months	15 (1 RCT) follow-up: 8 weeks	⊕◯◯◯ Very low[b,d]	RD 0.00 (-0.25 to 0.25)	0 per 1,000	**0 fewer per 1,000** (250 fewer to 250 more)[e]	Sample size used to determine precision: 75-150 = serious imprecision, <75 = very serious imprecision.
Discontinuation at ≥3 months	192 (2 RCTs) follow-up:	⊕◯◯◯	RD 0.03 (-0.08	200 per 1,000	**30 more per 1,000** (80 fewer	Precision calculated through

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with social support/stimulation	Risk difference with Computer-based tools for speech and language therapy	
	mean 8 months	Very low[d,f]	to 0.15)		to 150 more)[e]	Optimal Information Size (OIS) due to zero events in some studies. OIS determined power for the sample size = 0.08 (0.8-0.9 = serious, <0.8 = very serious).

a. Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs

b. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process)

c. Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis

d. Downgraded by 1 to 2 increments for imprecision due to zero events and small sample size

e. Absolute effect calculated by risk difference due to zero events in at least one arm of one study

f. Downgraded for heterogeneity due to conflicting number of events in different studies (zero events in one or more studies)

Table 6: Clinical evidence summary: computer-based tools for speech and language therapy compared to no treatment

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with no treatment	Risk difference with Computer-based tools for speech and language therapy	
Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change score and final value) at ≥3 months	49 (2 RCTs) follow-up: mean 5 months	⊕◯◯◯ Very low[a,b,c]	-	The mean communication - overall language ability at ≥3 months was 36.6	MD **5.39 higher** (1.16 lower to 11.95 higher)	MID = 7.0 (0.5 x median baseline SD)
Communication - impairment specific measures (naming) (verbal fluency, items, higher values are better, final value) at <3 months	20 (1 RCT) follow-up: 7 weeks	⊕◯◯◯ Very low[c,d]	-	The mean communication - impairment specific measures (naming) at <3 months was 62.5	MD **19.5 higher** (7.51 lower to 46.51 higher)	MID = 13.1 (0.5 x median baseline SD)
Communication - impairment specific measures (reading) (Reading Comprehension Battery for Aphasia subtests 7-9, 0-30, higher values are better, final value) at <3 months	21 (1 RCT) follow-up: 6 weeks	⊕◯◯◯ Very low[c,e]	-	The mean communication - impairment specific measures (reading) at <3 months was 19.8	MD **0.47 higher** (6.05 lower to 6.99 higher)	MID = 4.1 (0.5 x median baseline SD)
Communication - functional communication (Communication Activities of Daily Living [different scale ranges], higher values are	41 (2 RCTs) follow-up: mean 7 weeks	⊕◯◯◯ Very low[b,c,f]	-	-	SMD **0.12 SD higher** (1.12 lower to 1.36 higher)	MID = 0.5 SD (SMD)

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with no treatment	Risk difference with Computer-based tools for speech and language therapy	
better, final values) at <3 months						
Communication - functional communication (Communication Activities of Daily Living, 0-100, higher values are better, final value) at ≥3 months	34 (1 RCT) follow-up: 6 months	⊕◯◯◯ Very low[c,g]	-	The mean communication - functional communication at ≥3 months was 83	MD **6.81 higher** (1.4 higher to 12.22 higher)	MID = 4.0 (0.5 x median baseline SD)
Communication related quality of life (Assessment of Living with Aphasia, 0-4, higher values are better, final value) at <3 months	21 (1 RCT) follow-up: 6 weeks	⊕◯◯◯ Very low[c,e]	-	The mean communication related quality of life at <3 months was 2.48	MD **0.35 higher** (0.23 lower to 0.93 higher)	MID = 0.32 (0.5 x median baseline SD)
Communication related quality of life (Stroke aphasia quality of life-39 generic, 1-5, higher values are better, final value) at ≥3 months	34 (1 RCT) follow-up: 6 months	⊕⊕◯◯ Low[c,g]	-	The mean communication related quality of life at ≥3 months was 3.35	MD **0.38 higher** (0.08 lower to 0.84 higher)	MID = 0.30 (0.5 x median baseline SD)
Psychological distress - depression (Visual analog mood scales revised version, 0-100, lower values are better, final value) at <3 months	21 (1 RCT) follow-up: 6 weeks	⊕◯◯◯ Very low[c,e]	-	The mean psychological distress - depression at <3 months was 55.7	MD **0.3 higher** (13.72 lower to 14.32 higher)	MID = 6.4 (0.5 x median baseline SD)

				Anticipated absolute effects		
Outcomes	**№ of participants (studies) Follow-up**	**Certainty of the evidence (GRADE)**	**Relative effect (95% CI)**	**Risk with no treatment**	**Risk difference with Computer-based tools for speech and language therapy**	**Comments**
Discontinuation at <3 months	41 (2 RCTs) follow-up: mean 7 weeks	⊕◯◯◯ Very low[d,h]	RD 0.00 (-0.13 to 0.13)	0 per 1,000	**0 fewer per 1,000** (130 fewer to 130 more)[i]	Sample size used to determine precision: 75-150 = serious imprecision, <75 = very serious imprecision.
Discontinuation at ≥3 months	34 (1 RCT) follow-up: 6 months	⊕◯◯◯ Very low[c,g]	RR 2.25 (0.22 to 22.53)	56 per 1,000	**69 more per 1,000** (43 fewer to 1,196 more)	MID (precision) = RR 0.80 – 1.25.

a. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in measurement of the outcome)

b. Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis

c. Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs

d. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process and bias due to deviations from the intended interventions)

e. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process and bias in measurement of the outcome)

f. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions and bias in measurement of the outcome)

g. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process)

h. Downgraded by 1 to 2 increments for imprecision due to zero events and small sample size

i. Absolute effect calculated by risk difference due to zero events in at least one arm of one study

Table 7: Clinical evidence summary: computer-based tools for speech and language therapy compared to placebo

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with placebo	Risk difference with Computer-based tools for speech and language therapy	
Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change score) at <3 months	32 (1 RCT) follow-up: 6 weeks	⊕⊕◯◯ Low[a]	-	-	MD **0.99 higher** (0.5 higher to 1.48 higher)	MID = 8.83 (0.5 x median baseline SD)
Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change score) at ≥3 months	46 (2 RCTs) follow-up: mean 3 months	⊕◯◯◯ Very low[a,b]	-	-	MD **1.87 higher** (0.14 lower to 3.88 higher)	MID = 8.83 (0.5 x median baseline SD)
Communication - impairment specific measures (naming) (naming accuracy, unclear scale range, higher values are better, final value, crossover trial) at <3 months	100 (1 RCT) follow-up: 6 weeks	⊕⊕◯◯ Low[c,d]	-	The mean communication - impairment specific measures (naming) at <3 months was 13.99	MD **1.8 higher** (1.51 lower to 5.11 higher)	MID = 4.3 (0.5 x median baseline SD)
Discontinuation at <3 months	32 (1 RCT) follow-up: 6 weeks	⊕◯◯◯ Very low[d,e]	Peto OR 6.05 (0.56 to 65.53)	0 per 1,000	**160 more per 1,000** (30 fewer to 350 more)[g]	MID (precision) = Peto OR 0.80 – 1.25.
Discontinuation at ≥3 months	32 (1 RCT) follow-up: 3 months	⊕◯◯◯ Very low[d,e]	RR 2.05 (0.49 to 8.63)	154 per 1,000	**162 more per 1,000** (78 fewer	MID (precision) = RR 0.80 – 1.25.

Outcomes	№ of participants (studies) Follow-up	Certainty of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects		Comments
				Risk with placebo	Risk difference with Computer-based tools for speech and language therapy	
					to 1,000 more)	

a. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in measurement of the outcome)

b. Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis

c. Downgraded by 1 increment as the majority of the evidence was of high risk of bias (due to bias arising from the randomisation process)

d. Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs

e. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias due to deviations from the intended interventions and bias due to missing outcome data)

f. Absolute effect calculated by risk difference due to zero events in at least one arm of one study

See Appendix F for full GRADE tables.

1.1.7 Economic evidence

1.1.7.1 Included studies

Two health economic studies were included in this review.[20, 21] These studies were economic evaluations of a pilot feasibility trial (CACTUS)[39] and randomised controlled trial (Big CACTUS)[34]of the StepByStep computer program both of which were included in the clinical review. Both economic analyses were included in the review as:

- the CACTUS trial assessed computer exercises (3 days per week was recommended over 5-month period) that contained a combination of word finding and reading therapies,
- while BIG CACTUS assessed word-finding therapy computer exercises only and recommended that participants practice daily over 6-period.

These studies are summarised in the health economic evidence profile below (Table 8) and the health economic evidence table in Appendix H.

1.1.7.2 Excluded studies

No relevant health economic studies were excluded due to assessment of limited applicability or methodological limitations.

See also the health economic study selection flow chart in Appendix G.

1.1.8 Summary of included economic evidence

Table 8: Health economic evidence profile: Computer-based tools for speech and language therapy versus usual care

Study	Applicability	Limitations	Other comments	Incremental cost	Incremental effects	Cost effectiveness	Uncertainty
Latimer 2021[20] (CACTUS) (UK)	Directly applicable	Potentially serious limitations[(a)]	• Probabilistic model based on within-RCT analysis[34] • Cost-utility analysis (QALYs) • Population: Adults with aphasia (defined by a score of 5–43/48 on the Comprehensive Aphasia Test (CAT) Naming Objects test) who had had a stroke at least 4 months previously. • Comparators: 1) Usual care alone (UC) 2) Computerised word finding therapy plus usual care (CSLT) (mean time spent practicing: 28 hours) 3) Attention control plus usual care (AC) Time horizon: lifetime	2−1: £733[(b)] 2−3: £695[(b)] 3-1: £38[(b)]	2−1: 0.0172 QALYs 2−3: 0.0173 QALYs 3−1: -0.0001 QALYs	CSLT versus UC: £42,686 per QALY gained (not cost-effective) CSLT versus AC: £40,164 per QALY gained (not cost-effective) AC versus UC: Dominated (AC had higher costs and lower QALYs)	Probability of cost effective (£20K/£30K threshold): • Usual care: 56%/45%, • CSLT: 22%/32%, • Attention control: 22%/22%. ICERs for subgroups with moderate word finding difficulties were £13,673 per QALY gained for CSLT compared to AC plus usual care alone, which was the only cost-effective result found, and £21,262 per QALY gained for CSLT compared to usual care alone. Alternative costing assumptions (including the inclusion of volunteer costs) did not change conclusions on cost-effectiveness.
Latimer 2013[21] (Big CACTUS)	Partially applicable[(c)]	Potentially serious limitations[(d)]	• Probabilistic model based on within-RCT analysis[39]	£436.87[(e)]	0.14 QALYs	£3,058	Results of the model were sensitive to the utility gain (for example: utility gain of ≤0.01 resulted in ICER of >£20,000) and relapse rate

Study	Applicability	Limitations	Other comments	Incremental cost	Incremental effects	Cost effectiveness	Uncertainty
(UK)			• Cost-utility analysis (QALYs) • Population: Adults with a diagnosis of stroke and aphasia with word finding difficulties as one of the predominant features as assessed by the Comprehensive Aphasia Test (CAT) and the Object and Action Naming Battery. • Comparators: ○ 1) Usual stimulation (normal language stimulation activities and support groups) 2) Computerised word finding and reading therapy (home-based) plus usual stimulation (CSLT) (mean time practicing: 25 hours) • Time horizon: lifetime				parameters (for example: relapse rate of >30% resulted in ICER of >£20,000 (from a base case relapse rate of 0.08%)). ICER increased to £39,491 when 50% decrease to the base case utility gain (0.035 from 0.07) and increasing the relapse rate to 30% per month after month 5.

Abbreviations: ICER= incremental cost-effectiveness ratio; HRQoL= health-related quality of life; QALY= quality-adjusted life years; RCT= randomised controlled trial; SLT = speech and language therapy.

(a) The lifetime model was based on an RCT with a short follow up (12 months) and focused on one piece of software which could affect the generalisability of the analysis. The health-related quality of life benefit associated with a good response to computerised therapy was small and uncertain, making it difficult to ascertain whether adding computerised therapy to usual care leads to a QALY gain compared to usual care alone. Accessible version of the EQ-5D-5L questionnaire is not yet validated, and although this allows utility (HRQoL) scores to be elicited directly from people with aphasia, whose language difficulties may make it difficult to complete standard EQ-5D-5L questionnaires. Only direct intervention costs were included as Big CACTUS did not collect data on wider resource use, due to the pilot study finding no important differences in indirect resource use associated with computerised therapy compared to usual care.

(b) 2017 UK pounds. Cost components incorporated: intervention costs only including hardware and software costs (computers, including StepByStep software licences, headphones, puzzle books); SLT training costs; SLT, SLTA and volunteer time costs and travel costs.

(c) 2010 Unit costs may not reflect current UK NHS context and year of resource use estimates not reported.

(d) *The lifetime model was based on an RCT with a short follow up (8 months) and focused on one piece of software which could affect the generalisability of the analysis. Resource use was not estimated from a systematic review but from self-reported questionnaire. The utility of non-responders was assumed to be equal for the intervention group and control group, which overlooks the possibility that the utility for non-responders in the intervention group could be lower than the utility in the control group. The validity of the definition of a 'good response' is uncertain, as it was arbitrarily defined as those who demonstrated a word-finding improvement that was better than the average increase observed in the experimental group. Accessible version of the EQ-5D-5L questionnaire is not yet validated, although this allows utility (HRQoL) scores to be elicited directly from people with aphasia, whose language difficulties may make it difficult to complete standard EQ-5D-5L questionnaires. Finally, it should be noted that the sample size of the CACTUS trial was small (n=34) and aimed to assess the feasibility of a rigorous RCT of a self-managed computer therapy. Therefore, it cannot be expected to provide conclusive cost-effectiveness results.*

(e) *2010 UK pounds. Cost components included: Intervention costs, including the cost of computers, Step-by-Step software, microphones, and the cost of SLT training and support, which including setting up and assisting patients with the computer program. Resource use included GP, nurse, and other health care professional visits and consultations, as well as hospital admissions, appointments, and prescribed medication.*

1.1.9 Economic model

This area was not prioritised for new cost-effectiveness analysis.

1.1.10 Unit costs

Relevant unit costs are provided below to aid consideration of cost effectiveness.

Table 9: Unit costs of health care professionals who may be involved in delivering interventions involving computer-based tools for speech and language therapy

Resource	Cost per working hour (hospital / community) [(a)]	Source
Band 5 SLT	£40/£42	PSSRU 2021{, #4635}
Band 6 SLT	£53/£56	
Band 7 SLT	£64/£67	
Rehabilitation assistant	£33/£32	PSSRU 2021{, #4635}, estimated based on agenda for change band 3 salary[(b)]

Abbreviations: PSSRU= personal social services research unit; SLT= speech and language therapist.
(a) Note: Costs per working hour include salary, salary oncosts, overheads (management and other non-care staff costs including administration and estates staff), capital overheads and qualification costs.
(b) Band 3 not in PSSRU 2021 so salary was assumed to equal Band 3 Mean annual basic pay per FTE for administration and estates staff, NHS England (PSSRU2021 p.149).

Interventions involving computer-based tools for speech and language therapy require additional resource use over usual care. Studies included in the clinical review reported varied resource use (see Table 2 for details). Key differences in resource use were due to the following factors:

- The type of computer tool used varied across studies; Table 10 provides example costs associated with some of the tools that were assessed in the clinical review, with the cost per patient depending on both the type of software and whether multiple licences are purchased at once.
- Variation in method of delivery of therapy sessions: there was a mixture of studies assessing therapies delivered either in person or remotely, with one reporting a combination of both[37] Therapy delivered remotely is considered to be less resource intensive compared to face-to-face therapy.
- The frequency and duration of the intervention being delivered, with sessions ranging from 20-90 minutes, occurring 2-6 days per week, In the included clinical studies, the interventions were delivered for between 4-13 weeks.
- Staff who delivered the intervention varied as studies reported either physiotherapists, occupational therapists, or trained instructors. Palmer 2020[38] reported the use of SLTs and SLT assistants as well as trained volunteers to deliver the intervention.
- Study setting: interventions were conducted in hospitals, community centres, and outpatient rehabilitation centres. Non-clinical settings will incur lower or no costs compared to clinical settings.
- Additional resource use required to deliver the intervention, such as staff-training costs and information or instructional materials. Table 11 shows the summary costs provided in Marshall 2020,[25] which assessed the home-based EVA Park virtual reality program. This study also calculated the total per participant cost for the intervention (assuming 16 participants) was £1,364 when including hardware costs and £114 for an average online attendance (excluding hardware).

Table 10: Example costs of computer-based tools for the treatment of aphasia

Computer-based tool	Cost	Source
Claro Software[(a)]	£59/£215	Single Units of ClaroRead SE/ClaroRead[10]
Web ORLA[(b)]	£58	Shirley Ryan Ability Lab[41]
PowerAFA[(c)]	£56/£116/£258	Base (one patient/5 computers)/ Professional (10 patients/ 8 computers)/ Ultimate life-time licence (No limit to patients, up to 15 computers.[40]
StepbyStep© software [(d)]	£250/£550/£2200	Steps Consulting Ltd.[43] StepByStep aphasia therapy. Individual licence; clinician licence; clinician 5-licence

(a) Reported in Caute 2019[7] $85 converted using PPP[35]
(b) Reported in Cherney 2021[9]
(c) Reported in De Luca 2018[12]
(d) Palmer 2020[38]

Table 11: Summary costs from Marshall 2020[25]

	Total cost (£, 2017–18 prices)				
	North	East	South	West	Mean
Total cost for training[(a)]	£4,627	£1,738	£3,826	£3,465	£3,414
Total cost for project manager inputs to groups[(b)]	£1,835	£858	£1,416	£1,027	£1,284
Total cost for coordinator inputs to groups[(c)]	£2,610	£1,470	£1,829	£2,220	£2,032
Total cost for volunteer inputs to groups[(d)]	£829	£1,034	£779	£1,018	£915
Total hardware costs[(e)]	£1,245	£967	£697	£692	£901
Total software costs[(f)]	£1,416	£1,416	£1,416	£1,416	£1,416
TOTAL COST FOR GROUP (inc. hardware)	**£12,562**	**£7,483**	**£9,963**	**£9,838**	**£9,961**
TOTAL COST FOR GROUP (exc. hardware)	**£11,316**	**£6,516**	**£9,265**	**£9,146**	**£9,061**
Average cost per participant (exc. hardware)	£2,263	£724	£1,324	£1,143	£1,364
Average cost per online attendance (exc. hardware)	£195	£68	£101	£91	£114

(a) Training consisted of two 4-hour sessions for coordinators and volunteers
(b) 2017/18 Hourly cost for an NHS community based SLT principal obtained from PSSRU 2018[11]
(c) £29.99 per working hour. Calculation assumes a co-ordinator salary of £27581 p.a., 30% salary on-costs at £8274 p.a. and 30% institutional overheads upon total salary at £10757. Working time assumed as 42 working weeks p.a./37 hours per week. Co-ordinator base salary obtained from figures used in research funding proposal.
(d) Hour of leisure time (£6.86); DoT document reports the perceived cost of non-working time for 'other' purpose to be £6.04 at 2010 prices. 2010 value uprated to 2017/18 prices using GDP inflator of 13.6%, obtained from PSSRU 2018[11]. Value of leisure time obtained from the Department for Transport (2014): Transport Analysis Guidance (TAG).[13]
(e) Laptop cost (£135): Purchase price assumed as £810 for a 'gaming' laptop (e.g., HP ProBook 450 2017). Per user cost assumed as 1/6 of full cost based on 6-month loan and 3-year life span. (Cost not annuitised). Headset £3.33: Purchase price assumed as £20. Per user cost assumed as 1/6 of full cost based. Ethernet cable (£1.33) Purchase price assumed as £8. Per user cost assumed as 1/6 of full cost based on 6-month loan and 3-year life span (Cost not annuitised); Dongle (£5).

(f) Software hosting (£38.25), Last bill paid by project = 435.60 Euros for one year. This is equivalent to £383 per year (or £31.92 per month) based on an average 2017/18 currency conversion rate of 0.8793.[17] Assuming that a group runs for 6 months, and uses only 20% of the software's capacity, the total cost per group = £38.

1.1.11 Evidence statements

Effectiveness/Qualitative

Economic

- One cost-utility analysis found that in post-stroke adults with aphasia, computerised word-finding therapy was not cost-effective when compared to usual care alone (ICER of £42,686 per QALY gained) or when compared to attention control plus usual care (ICER of £40,164 per QALY gained). This study was assessed as directly applicable with potentially serious limitations.

- One cost-utility analysis found that in post-stroke adults with aphasia, computerised word-finding and reading therapy was cost-effective when compared to usual care alone (ICER of £3,058 per QALY gained). This study was assessed as partially applicable with potentially serious limitations.

1.1.12 The committee's discussion and interpretation of the evidence

1.1.12.1. The outcomes that matter most

The committee included the following outcomes: person/participant generic health-related quality of life, carer generic health-related quality of life, communication outcomes, including: overall language ability, impairment specific measures (such as naming, auditory comprehension, reading, expressive language and speech impairment and activity for people with dysarthria) and functional communication, communication related quality of life, psychological distress (including depression, anxiety and distress) and discontinuation. All outcomes were considered equally important for decision making and therefore have all been rated as critical.

Person/participant health-related quality of life outcomes were considered particularly important as a holistic measure of the impact on the person's quality of living. However, the committee acknowledged that generic measures may be more responsive to physical changes after stroke and less responsive to communication changes, and this may affect the interpretation of the outcome. In particular, for EQ-5D, the committee noted that there are no subscales specific to communication, which makes it hard to relate to speech and language therapy. In response to this, communication related quality of life scores were also included. Communication outcomes were key to this review as a direct answer to the question. Psychological distress was included as a response to the significant psychological distress that can be experienced by people with communication difficulties that may be resolved by the treatment. Discontinuation was considered as a measure of adherence to the treatment with the acknowledgement that there are unlikely to be significant adverse events as a result of the treatment. Mortality was not considered as it was deemed unlikely to be a result of the treatment. However, if mortality was a reason for discontinuation, then this was highlighted to the committee during their deliberation.

The committee chose to investigate these outcomes at less than 3 months and more than and equal to 3 months, as they considered that there could be a difference in the short term and long term effects of the interventions, in particular for people who have had an acute stroke where effects at less than 3 months could be very different then effects at greater than

3 months. With regards to communication difficulties, this may be seen at 3 months, in contrast to other reviews for this guideline where 6 months was used.

The evidence for this question was limited, with some outcomes not being reported. No study investigated the effects of interventions on carer generic health-related quality of life and the anxiety and distress sections of psychological distress. Outcomes were reported at both less than 3 months and more than and equal to 3 months.

1.1.12.2 The quality of the evidence

Twenty randomised controlled trial studies (including 1 cross-over trial and three quasi-randomised trials) were included in the review. The 3 quasi-randomised trials were included due to the limited evidence investigating computer-based tools for speech and language therapy. However, the limitations produced by the study design was reflected in the risk of bias assessment. Non-randomised studies were considered for this review. However, none were identified that fulfilled the protocol criteria.

The quality of the evidence ranged from high to very low quality, most of the evidence being of low quality. Outcomes were commonly downgraded due to risk of bias (mainly due to bias arising from the randomisation process, bias due to deviations from the intended intervention and bias due to missing outcome data) and imprecision. No outcomes were affected by indirectness.

Some outcomes were downgraded for inconsistency. However, this was less common as meta-analysis was not possible for the majority of outcomes, with only 1 study being included in most outcomes. Where heterogeneity was identified, subgroup and sensitivity analyses did not resolve this mainly due to the limited number of studies making it not possible to form valid subgroups. In general, the majority of studies included people with aphasia, with a minority including people with dysarthria, people with apraxia of speech and a combination of people with other communication difficulties and aphasia. The majority of studies included people in the chronic phase after stroke, with only occasional studies including people in the subacute phase. The types of computer-based tools used varied across the studies, with the majority including a combination of approaches. There was a mixture of therapies being delivered in person and being delivered remotely. The amount of therapy varied between studies ranging from less than and equal to 10 hours to more than and equal to 30 hours.

The majority of the studies included a small number of participants (the majority including 10 to 20 participants in each study arm), while few studies included a larger number of participants (at most around 100 participants in each study arm).

These factors introduced additional uncertainty in the results. The effects on risk of bias did not appear to influence the direction of the effect in the trials. The committee took all these factors into account when interpreting the evidence.

The committee concluded that the evidence was of sufficient quality to make recommendations. They acknowledged the varied quality of the evidence and the heterogeneity in the interventions being compared in this analysis. They committee noted the study size and variations that may occur from studies conducted outside of an NHS-based healthcare setting. However, a large multi-site NIHR funded study[37] recently took place in the United Kingdom which included a health economic analysis. The study reported the use of a word finding computer-based therapy compared to social support/stimulation and speech and language therapy without computer-based tools. The study reported many of the outcomes included in this review and was of low risk of bias. Therefore, the committee gave this study greater consideration in their decision making.

1.1.12.2.1 Computer-based tools compared to speech and language therapy without computer-based tools

The majority of identified evidence was considered to be categorised in this comparison. When compared to speech and language therapy without computer-based tools, 39 outcomes were reported that ranged between high and very low quality. Where downgraded, outcomes were commonly downgraded due to risk of bias (due to a mixture of bias arising from the randomisation process, bias due to deviations from the intended intervention, bias due to missing outcome data and bias in measurement of the outcome) and imprecision. Two outcomes were downgraded for inconsistency due to the outcomes including a mixture of studies reporting zero events in at least 1 study arm and studies reporting events in both study arms.

1.1.12.2.2 Computer-based tools compared to social support/stimulation

When compared to social support/stimulation, 7 outcomes were reported that ranged from high to very low quality. When downgraded, outcomes were commonly downgraded due to risk of bias (due to bias arising from the randomisation process) and imprecision. Two outcomes were downgraded for inconsistency either as heterogeneity was observed and not resolved by sensitivity analysis or subgroup analysis or that the outcome included a mixture of studies reporting zero events in at least 1 study arm and studies reporting events in both study arms.

1.1.12.2.3 Computer-based tools compared to no treatment

When compared to no treatment, 7 outcomes were reported that ranged from low to very low quality, with the majority being of very low quality. Outcomes were commonly downgraded due to risk of bias (due to a mixture of bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in measurement of the outcome) and imprecision. One outcome was downgraded for inconsistency either as heterogeneity was observed and not resolved by sensitivity analysis or subgroup analysis.

1.1.12.2.4 Computer-based tools compared to placebo

When compared to placebo, 5 outcomes were reported that ranged from low to very low quality, with the majority being of very low quality. Outcomes were commonly downgraded due to risk of bias (due to a mixture of bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in measurement of the outcome) and imprecision. One outcome was downgraded for inconsistency either as heterogeneity was observed and not resolved by sensitivity analysis or subgroup analysis.

1.1.12.3 Benefits and harms

1.1.12.3.1 Key uncertainties

The committee agreed that there was significant heterogeneity in the interventions included in the analysis, reflecting the complexity and range of speech and language therapy needs that can be targeted by computerised therapy. The interventions varied from computer programs aiming to deliver speech and language therapy to telerehabilitation approaches aiming to support speech and language therapist to deliver therapy over long distances. A subgroup analysis for remote delivery compared to in person delivery of therapy did not resolve any heterogeneity in the analysis. Furthermore, the types of computer programs used to deliver therapy varied significantly. While some focussed on specific methods of therapy (for example: word finding therapy) others included a mixture of approaches aiming for more holistic delivery of therapy. A subgroup analysis for the method of therapy did not resolve any heterogeneity in the analysis.

The comparisons included varied within groups. For the computer-based tools compared to speech and language therapy without computer-based tools comparison, comparisons could be split into two categories:

- Speech and language therapy with computer-based tools compared to equal amounts of therapy without computer-based tools (intensity and duration matched)
- Speech and language therapy with computer-based tools in addition to speech and language therapy delivered in person compared to in person delivery only (usual care with additional computer-based tools)

The committee noted that computer-based tools for speech and language therapy would most likely not be used as the only speech and language therapy for a person. Speech and language therapy with computer-based tools can often allow for training in activities where repetition is required, but it is often harder to adapt to the person's needs. The approach can make it harder for the person after stroke to feel they are receiving adequate attention if it is not adequately supported by a health care professional or is not person centred, and this may reduce their motivation to continue with the computer therapy. The committee noted that personalisation was possible with some computer software, but this will incur additional costs for staff to be involved with this process (including additional time with people to discuss how the therapy is going). The approaches used in the studies varied.

The committee noted that the evidence included mostly small studies with very few participants and so it was difficult to make firm conclusions about the efficacy of the intervention. The majority of interventions appeared to include components of word finding, but there were very few interventions looking at other methods of therapy. In addition, the majority of evidence was for people with aphasia with very few studies involving people with other types of speech and language difficulties (such as dysarthria and apraxia of speech). The committee agreed that additional research with larger sample sizes, computerised therapy focussed on other aspects of speech and language impairment, and ways to support use of new speech and language skills in everyday communication situations would be important for future work.

1.1.12.3.2 Computer-based tools compared to speech and language therapy without computer-based tools, social support/stimulation, no treatment and placebo

When compared to speech and language therapy without computer-based tools, clinically important benefits were seen for psychological distress – depression and discontinuation at less than 3 months and more than and equal to 3 months. Unclear effects where some outcomes indicated a clinically important benefit of computer-based tools, while others indicated no clinically important difference was seen for naming at less than 3 months and more than and equal to 3 months and expressive language at more than and equal to 3 months. An unclear effect where some outcomes indicated a clinically important benefit of computer-based tools (including 30 participants), while others indicated a clinically important benefit of speech and language therapy without computer-based tools (including 198 participants) was seen for person/participant generic health-related quality of life at more than and equal to 3 months. No clinically important difference was seen for overall language ability, reading functional communication and communication related quality of life at less than 3 months and more than and equal to 3 months and auditory comprehension, expressive language, speech impairment – dysarthria and activity – dysarthria at less than 3 months. An unclear effect where some outcomes indicated no clinically important difference, while others indicated a clinically important benefit of speech and language therapy without computer-based tools was seen for auditory comprehension at more than and equal to 3 months.

When compared to social support/stimulation, clinically important benefits were seen for naming at less than 3 months and more than and equal to 3 months. No clinically important difference was seen in person/participant generic health-related quality of life, functional communication and communication related quality of life at more than and equal to 3 months and discontinuation at less than 3 months and more than and equal to 3 months. When compared to no treatment, clinically important benefits were seen for naming and communicated related quality of life at less than 3 months. No clinically important difference was seen in overall language ability, expressive language, functional communication, depression and discontinuation at less than 3 months. When compared to placebo, no clinically important difference was seen for overall language ability at less than 3 months and more than and equal to 3 months and naming at less than 3 months. Clinically important harms of computer-based tools were seen in discontinuation at less than 3 months and more than and equal to 3 months.

The committee noted that the evidence was complicated to examine due to the variety of computer-based tools being meta-analysed that were examining different techniques. The intervention of note had a high degree of interventional complexity that made it complicated to fully understand using this analysis. However, the committee weighed up the benefits and the harms from the evidence available. Benefits were seen in naming therapies that were either focussed on word finding or included word finding as a component. The committee noted that this was realistic but highlighted that this did not necessarily make a difference on a person's ability to communicate. They noted that word finding may be useful for finding specific words, but not necessarily to use those words in communication and required extra support to put those words into context. No clinically important differences were seen in functional communication, which may indicate that the ability to use words in context may not have been achieved with these therapies.

The committee noted that the outcome reported for person/participant generic health-related quality of life was EQ-5D, that did not specifically include a subscale for communication. Due to this, it is difficult to conclude that the interventions are or are not effective based on this outcome. Therefore, the committee did not give the outcome a large weighting in their decision when making recommendations.

The committee considered the clinically important harm in discontinuation when computer-based tools were compared to placebo. People dropped out for unclear reasons during the first 2 weeks of therapy in 1 study in the group using computer-based tools, which may reflect dissatisfaction with the computer-based therapy though this is uncertain. Weighing up this evidence against the potential evidence of benefits, the committee decided that the evidence of benefit outweighed the potential for harm from this. If people found that computer-based tools were not suitable for them then they could work with their therapist to explore other methods of therapy, including methods that do not use computer-based tools.

The committee agreed that computer-based tools for speech and language therapy should be used as an adjunct to speech and language therapy, not alone. There was insufficient evidence of clinically important changes in anything except in improving word finding. Most of the evidence was from small studies and it was not possible to make recommendations, either positive or negative, for other uses of computer-based speech and language tools. Based on this they agreed that computer-based tools could be considered where word finding is an important aim for the person after stroke and they should be used as an adjunct to therapy delivered by a speech and language therapist. However, there should also be additional research with larger sample sizes investigating the other potential uses of computer-based tools for speech and language therapy to gain a complete understanding of the effect of the interventions.

1.1.12.4 Cost effectiveness and resource use

The economic evidence review included 2 published studies with relevant comparisons. These studies were economic evaluations of a pilot feasibility trial (CACTUS) and a randomised controlled trial (Big CACTUS) of the StepByStep computer program, respectively

- both of which were included in the clinical review. The StepByStep software allowed for participants to receive supported self-managed intensive speech practice at home. Both studies were UK model-based cost-utility analyses with lifetime horizons, although the interventions differed slightly as described in the following paragraphs.

The CACTUS trial compared the StepByStep approach (computer exercises, support from an SLT and a volunteer who practiced carryover activities face to face) to usual stimulation, which included activities that provided general language stimulation, such as communication support groups and conversation, as well as reading and writing activities. The analysis included a three-state Markov model with month-long cycles, whereby participants could transition from their initial aphasia health state to a response state (defined as a ≥17% increase in proportion of words named correctly at 5 months), or to death. Patients in the response state could relapse to the aphasia state or die. Utility weights were assigned to response and no response states to estimate QALYs, which were measured using a pictorial version of EQ-5D-3L (adapted for this study to be accessible to patients with aphasia) collected at baseline and at 5-and 8-months. 5-month utility data was then extrapolated to a lifetime horizon with 0.08% monthly relapse rate applied. Intervention costs included computers and microphones provided to participants, as well StepByStep software and training for speech and language therapists (SLTs). Healthcare resource use between both groups was also compared using patient and carer diaries collected at 5 months post-randomisation. After 5 months, resource use costs were assumed to be the same for both groups by applying 5-month resource use estimates collected from the control group. The results of the CACTUS trial suggested that StepByStep was cost-effective, with an incremental cost of only £437 for an incremental QALY gain of 0.14, producing an incremental cost-effectiveness ratio (ICER) of £3,058 per QALY gained. Probabilistic sensitivity analyses also suggested that the probability of the intervention being cost-effective was 75.8% at a £20,000 threshold. However, deterministic sensitivity analyses found that the base case results were sensitive to utility gain (for example, utility gain of ≤0.01 resulted in ICER of >£20,000) and relapse rate parameters (for example, relapse rate of >30% resulted in ICER of >£20,000).

This study was assessed as partially applicable for this review, as 2010-unit costs may not reflect the current UK NHS context and the year in which resource use estimates were collected was not reported. Potentially serious limitations were also identified, as the lifetime model was based on an RCT with a short follow up (8 months) and focused on one piece of software which limits interpretation for the wider evidence base identified in the clinical review. Additional limitations included: resource use estimates were taken from a self-reported questionnaire not from a systematic review; utility of non-responders assumed to be equal for both trial groups, overlooking the possibility that non-responder utility scores could be lower in the intervention group; the definition of a “good response” was arbitrarily defined, and how the accessible version of the EQ-5D-3L questionnaire is yet to be validated, although this did allow for utility scores to be elicited directly from people with aphasia. Finally, it should be noted that the sample size of the CACTUS trial was small (n=34) and aimed to assess the feasibility of a rigorous RCT of a self-managed computer therapy. Therefore, it cannot be expected to provide conclusive cost-effectiveness results.

For this reason, an economic evaluation of Big CACTUS trial was conducted. The trial compared the StepByStep program to both usual care and an attention control arm, who received puzzle books and monthly supportive telephone calls plus usual care. The StepByStep intervention was delivered both remote and in-person, supported by volunteers and SLT assistants. The Markov model included with 3-month cycles where all participants begin in the ‘aphasia’ health state but differed from the model used in the CACTUS trial, as it included two tunnel heath states for ‘good response’ (defined as a ≥10% increase in words correctly found on a naming test and/or a 0.5 increase on the Therapy Outcomes Measures activity scale) at 6 and 9 months from baseline. No new responses were assumed to occur after 12 months – participants either remained in the ‘good response (12 months and beyond), relapsed to the 'Aphasia' health state or die. People in the 'Aphasia' health state at 12 months either remain in that health state or die. Utility weights were assigned to response and no response states to estimate QALYs, which were measured using an adapted pictorial version of EQ-5D-5L collected at baseline, 6, 9 and 12 months. EQ-5D-5L scores were also mapped to EQ-5D-5L using an algorithm by Van Hout 2012[44]. The relapse rate observed between 9 and 12 months was assumed to remain constant for the remainder of the modelled period, hence it was assumed that good responses were lost over time. Only intervention costs were incorporated into the model, which included hardware and software costs (computers, including StepByStep software licences, headphones, puzzle books), SLT training costs and volunteer time/travel costs for SLTs and SLT assistants.

The results found that StepByStep was not cost-effective when compared to usual care, as the QALY gain associated with the intervention was small (0.017) relative to the incremental cost (£733), resulting in an ICER of £42,686 per QALY gained. The same result was found when the intervention was compared to the active control group (£40,165 per QALY gained). The active control group was also dominated by usual care, having higher costs (£695) and lower QALYs (-0.0001). The probability that usual care was cost-effective was 56% at a £20,000 threshold, compared to 22% for both the active control and StepByStep groups. The only cost-effective result identified for the StepByStep intervention was when only patient subgroups with moderate word finding difficulties were assessed, which reported an ICER of £13,673 per QALY gained when compared to the active control group, and £21,262 per QALY gained for StepByStep compared to usual care alone. Alternative costing assumptions (including the inclusion of volunteer costs) did not change conclusions on cost-effectiveness. The study was deemed as directly applicable with potentially serious limitations for the following reasons: This lifetime model was based on an RCT with a short follow up (12 months) and assessed a single piece of software; the health-related quality of life benefit of a "good response" for the StepByStep intervention was small and uncertain; only direct intervention costs were included as Big CACTUS did not collect data on wider resource use (due to the CACTUS pilot study reporting no important differences in indirect resource use) and the how the accessible version of the EQ-5D-5L questionnaire is yet to be validated.

In addition to the economic evidence, unit costs of computer-based tools and health care professionals that were reported in the clinical studies were presented to aid committee discussion. Additional resource use would be required for computer-based therapy, and variation in resource use across studies reported in the clinical review highlighted the uncertainty towards the potential resource impact of these interventions on the NHS. For example, the cost per patient for these tools depends on both the type of software and whether multiple licences are purchased at once. The intervention setting would also affect the resource impact, as the clinical studies reported interventions that were conducted in hospitals, community centres, and outpatient rehabilitation centres, as well as those that were delivered remotely. Non-clinical settings will incur lower or no costs compared to clinical settings, while remote-based therapies are considered to be less resource intensive compared to face-to-face therapy. Differences in the frequency and duration of therapy delivery were also reported, with sessions ranging from 20-90 minutes, occurring 2-6 days per week, for a total of 4-13 weeks. Staff who delivered the intervention varied as studies reported using physiotherapists, occupational therapists, or trained instructors. The Big CACTUS RCT also reported the use of SLTs and SLT assistants as well as trained volunteers to deliver the intervention. Studies also reported other various resource use requirements, such as staff-training costs and information or instructional materials.

The committee discussed economic evidence, noting that the results of the two included studies could not be used to reflect the cost-effectiveness of the wider evidence base as they assessed a single computer program that required substantial resource use in terms of hardware and software costs compared to other interventions identified in the clinical review. Neither version of the StepByStep program is widely available as part of current practice which would increase the resource impact if recommended. Further uncertainty of the cost-effectiveness was raised when considering the variation in the delivery and resource use requirements of the interventions reported in the clinical studies. The committee agreed that there would be a resource impact for providing computer-based therapy as this is not routinely used in current practice.

Although the clinical studies varied in quality, with significant uncertainty due to the complexity of the interventions, clinically important benefits were seen for naming when interventions focused on or included word finding as a component. This led the committee to agree that computer-based interventions aimed at improving naming skills may be useful as additional therapy, as the majority of studies provided computer-based therapy in addition to face-to-face speech and language therapy. The committee also specified that such interventions should be adapted to the needs of the person (for example, word finding activities that include terms which are important to the user). Considering the uncertainty of the clinical evidence and limited economic evidence, the committee proposed a 'consider' recommendation for computer-based therapy programmes tailored to individual goals in relation to naming in addition to face-to-face speech and language therapy.

1.1.12.5 Other factors the committee took into account

The committee noted the potential inequity of using programs that are only available in English and notes that there will be some people who cannot access this due to speaking other languages. They noted the complexities for multilingual people who may have therapy focussed on their use of English instead of including all languages that a person may speak. Computer-based tools may exacerbate this inequity in care and so the committee highlighted that it is important to consider all languages that a person speaks and providing holistic support for the person.

The committee noted that computer-based tools may not be accessible for all people, dependent on multiple factors including their access to technology due to cost and computer literacy. Hospitals may be able to lend out technology and provide additional support to people to use it, but it was noted that there may be a geographic variation in the effect of this with a greater requirement for technology to be leant out in areas where there is greater socioeconomic deprivation.

The committee agreed that computer-based tools should not be used as the only speech and language therapy someone should be offered, and that all people who require speech and language therapy should receive support from a speech and language therapist. However, there is currently insufficient available speech therapist time in many Stroke Units, and computer-based tools could be an important means of increasing the intensity of therapy someone could receive (see Evidence review E).

The committee noted that there could be wider effect on psychological outcomes. Some outcomes for evidence were not available for this review, such as outcomes on psychological distress for group-based computer-based tools. The committee discussed how this may help with psychological wellbeing by integrating with other people after stroke.

1.1.13 Recommendations supported by this evidence review

This evidence review supports recommendation 1.12.8 and the research recommendation on computer-based speech and language therapy.

1.1.14 References

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Appendices

Appendix A – Review protocols

Review protocol for the clinical and cost-effectiveness of computer-based tools to augment speech and language therapy in people with aphasia after stroke

ID	Field	Content
0.	PROSPERO registration number	CRD42021276241
1.	Review title	In people with aphasia after stroke, what is the clinical and cost effectiveness of computer-based tools to augment speech and language therapy?
2.	Review question	4.5 In people with aphasia after stroke, what is the clinical and cost effectiveness of computer-based tools to augment speech and language therapy?
3.	Objective	To determine the clinical and cost effectiveness of computer-based tools to augment speech and language therapy in people with communication difficulties after stroke.
4.	Searches	The following databases (from inception) will be searched: • Cochrane Central Register of Controlled Trials (CENTRAL) • Cochrane Database of Systematic Reviews (CDSR) • Embase • MEDLINE • Epistemonikas • AMED Searches will be restricted by: • English language studies • Human studies Other searches: • Inclusion lists of systematic reviews The searches may be re-run 6 weeks before the final committee meeting and further studies retrieved for inclusion if relevant. The full search strategies will be published in the final review.

		Medline search strategy to be quality assured using the PRESS evidence-based checklist (see methods chapter for full details).
5.	Condition or domain being studied	Adults and young people (16 or older) after a stroke
6.	Population	Inclusion: • Adults (age ≥16 years) who have had a first or recurrent stroke (including people after subarachnoid haemorrhage) who have communication difficulties Exclusion: • Children (age <16 years) • People who had a transient ischaemic attack
7.	Intervention	• Computer-based tools for speech and language therapy (to deliver therapy)
8.	Comparator	• Speech and language therapy without computer-based tools (usual care) • Social support/stimulation • No treatment • Placebo Confounding factors (for non-randomised studies only): • Severity of the communication disorder • Length of time post stroke • Age

9.	Types of study to be included	• Systematic reviews of RCTs
		• Parallel RCTs
		• Cluster randomised trials
		• Crossover studies (for people after chronic stroke only)
		• Non-randomised studies (if insufficient RCT evidence is available)
		  o Prospective cohort studies
		  o Retrospective cohort studies
		
		Published NMAs and IPDs will be considered for inclusion.

10.	Other exclusion criteria	• Non-English language studies • Non comparative cohort studies • Before and after studies

		• Crossover RCTs (for people after acute/subacute stroke) • Conference abstracts will be excluded as it is expected there will be sufficient full text published studies available. • Telerehabilitation primarily aimed to support people who do not require speech and language therapy • Alternative methods of communication (for example: AAC)
11.	Context	People with aphasia after a stroke. This may include people in an acute, subacute or chronic time horizon.

12.	Primary outcomes (critical outcomes)	All outcomes are considered equally important for decision making and therefore have all been rated as critical:
		At time period:
		• <3 months
		• ≥3 months
		
		• Person/participant generic health-related quality of life (continuous outcomes will be prioritised [validated measures])
		  o EQ-5D
		  o SF-6D
		  o SF-36
		  o SF-12
		  o Other measures (AQOL, HUI, 15D, QWB)
		• Carer utility health-related quality of life (continuous outcomes will be prioritised [validated measures])
		  o EQ-5D
		  o SF-6D
		  o SF-36
		  o SF-12
		  o Other utility measures (AQOL, HUI, 15D, QWB)
		• Communication (continuous outcomes will be prioritised)
		  o Overall language ability
		    – Western Aphasia Battery
		    – Comprehensive Aphasia Test (CAT)
		    – Boston Diagnostic & Aphasia Examination
		    – Porch Index of Communicative Ability
		    – Frenchay Aphasia Screening Test
		  o Impairment specific measures
		    – Naming
		      • Boston Naming Test (BNT)

		• Picture naming test of personally relevant words (bespoke) • Comprehensive Aphasia Test (CAT) naming objects subscale – Auditory comprehension • Aachen Aphasia Test, Token Test • Comprehensive Aphasia Test (CAT) Comprehension Test subscale – Reading • Comprehensive Aphasia test word reading and/or non-word reading – Expressive language • Comprehensive Aphasia Test picture description – Speech impairment (dysarthria) • Frenchay Dysarthria Assessment 1 or 2 • Assessment of intelligibility of Dysarthria speech • Acoustic and perceptual measures of voice and speech (e.g. vocal profile analysis, pitch loudness, air flow, sound spectrography) • Iowa Oral Performance Instrument – Activity (dysarthria) • Therapy Outcome Measures dyarthria activity scale • Dysarthria Impact Porfile • Communication Outcomes after Stroke (COAST) o Functional communication – Aachen Aphasia Test, spoken communication domain score – Amsterdam-Nijmegen Everyday Language Test (ANELT) – Therapy Outcome Measures (TOMs) aphasia activity scale • Communication related quality of life (continuous outcomes will be prioritised) o Stroke and Aphasia Quality of Life Scale (SAQoL) o Communication Outcomes After Stroke (COAST) o Carer Communication Outcomes After Stroke • Psychological distress (continuous outcomes and aphasia specific measurement tools will be prioritised) o Depression – Depression Intensity Scale Circles

		– Stroke Aphasic Depression Questionanaire (SADQ-10) – Signs of Depression Scale (SODS) – Aphasic Depression Rating Scale (ADRS) – Visual Analogue Mood Scale (VAMS) sad item – PHQ-9 – HADS-D – Beck Depression Inventory – Hamilton Depression Scale – Centre of Epidemiologic Studies Depression (CES-D) – GHQ-28 – Geriatric Depression Scale o Anxiety – Behavioural Outcomes of Anxiety – GAD-7 – HADS-A – The Geriatric Anxiety Inventory – GHQ-28 – Beck Anxiety Inventory o Distress – The Distress Management System for Stroke • Discontinuation (dichotomous outcome)
14.	Data extraction (selection and coding)	All references identified by the searches and from other sources will be uploaded into EPPI reviewer and de-duplicated. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer. The full text of potentially eligible studies will be retrieved and will be assessed in line with the criteria outlined above. A standardised form will be used to extract data from studies (see Developing NICE guidelines: the manual section 6.4). 10% of all evidence reviews are quality assured by a senior research fellow. This includes checking: • papers were included /excluded appropriately • a sample of the data extractions • correct methods are used to synthesise data • a sample of the risk of bias assessments Disagreements between the review authors over the risk of bias in particular studies will be resolved by

		discussion, with involvement of a third review author where necessary.
15.	Risk of bias (quality) assessment	Risk of bias will be assessed using the appropriate checklist as described in Developing NICE guidelines: the manual. • Systematic reviews: Risk of Bias in Systematic Reviews (ROBIS) • Randomised Controlled Trial: Cochrane RoB (2.0) • Non randomised study, including cohort studies: Cochrane ROBINS-I
16.	Strategy for data synthesis	• Pairwise meta-analyses will be performed using Cochrane Review Manager (RevMan5). Fixed-effects (Mantel-Haenszel) techniques will be used to calculate risk ratios for the binary outcomes where possible. Continuous outcomes will be analysed using an inverse variance method for pooling weighted mean differences. Heterogeneity between the studies in effect measures will be assessed using the I² statistic and visually inspected. An I² value greater than 50% will be considered indicative of substantial heterogeneity. Sensitivity analyses will be conducted based on pre-specified subgroups using stratified meta-analysis to explore the heterogeneity in effect estimates. If this does not explain the heterogeneity, the results will be presented pooled using random-effects. • GRADEpro will be used to assess the quality of evidence for each outcome, taking into account individual study quality and the meta-analysis results. The 4 main quality elements (risk of bias, indirectness, inconsistency and imprecision) will be appraised for each outcome. Publication bias is tested for when there are more than 5 studies for an outcome. The risk of bias across all available evidence was evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group http://www.gradeworkinggroup.org/ • Where meta-analysis is not possible, data will be presented and quality assessed individually per outcome. WinBUGS will be used for network meta-analysis, if possible given the data identified.
17.	Analysis of sub-groups	Subgroups that will be investigated if heterogeneity is present: Severity of communication difficulty (as stated by category):

		• Mild • Moderate • Severe • Very severe Type of communication difficulty • Aphasia • Dysarthria • Cognitive Communication • Apraxia of speech • Mixed Total number of hours of therapy delivered using computer tools: • ≤10 hours • 11-20 hours • 21-30 hours • >30 hours Time after stroke at the start of the trial • Hyperacute <72 hours • Acute 72 hours – 7 days • Subacute 7 days – 6 months • Chronic >6 months Remote delivery compared to in person delivery of sessions • Remote delivery • In person delivery • Mixed Method of therapy • Word finding therapy • Reading therapy • Writing therapy • Comprehension therapy • Expressive language/communication • Articulation therapy • Pitch and volume/melodic therapies • Combination of the above • Other	
18.	Type and method of review	☒	Intervention

		☐	Diagnostic	
		☐	Prognostic	
		☐	Qualitative	
		☐	Epidemiologic	
		☐	Service Delivery	
		☐	Other (please specify)	
19.	Language	English		
20.	Country	England		
21.	Anticipated or actual start date	24/02/2021		
22.	Anticipated completion date	14/12/2022		
23.	Stage of review at time of this submission	Review stage	Started	Completed
		Preliminary searches	☐	☐
		Piloting of the study selection process	☐	☐
		Formal screening of search results against eligibility criteria	☐	☐
		Data extraction	☐	☐
		Risk of bias (quality) assessment	☐	☐
		Data analysis	☐	☐
24.	Named contact	5a. Named contact National Guideline Centre 5b Named contact e-mail StrokeRehabUpdate@nice.nhs.uk 5e Organisational affiliation of the review National Institute for Health and Care Excellence (NICE) and National Guideline Centre		
25.	Review team members	From the National Guideline Centre: Bernard Higgins (Guideline lead) George Wood (Senior systematic reviewer) Madelaine Zucker (Systematic reviewer) Kate Lovibond (Health economics lead) Claire Sloan (Health economist) Joseph Runicles (Information specialist)		

		Nancy Pursey (Senior project manager)
26.	Funding sources/sponsor	This systematic review is being completed by the National Guideline Centre which receives funding from NICE.
27.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.
28.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/indevelopment/gid-ng10175
29.	Other registration details	N/A
30.	Reference/URL for published protocol	N/A
31.	Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: • notifying registered stakeholders of publication • publicising the guideline through NICE's newsletter and alerts • issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.
32.	Keywords	Adults; Aphasia; Dysarthria, Communication; Intervention; Intensity; Rehabilitation; Speech and Language Therapy; Stroke
33.	Details of existing review of same topic by same authors	N/A
34.	Current review status	☐ Ongoing ☐ Completed but not published

		☒	Completed and published
		☐	Completed, published and being updated
		☐	Discontinued
35..	Additional information	N/A	
36.	Details of final publication	www.nice.org.uk	

Health economic review protocol

Review question	All questions – health economic evidence
Objectives	To identify health economic studies relevant to any of the review questions.
Search criteria	• Populations, interventions and comparators must be as specified in the clinical review protocol above. • Studies must be of a relevant health economic study design (cost–utility analysis, cost-effectiveness analysis, cost–benefit analysis, cost–consequences analysis, comparative cost analysis). • Studies must not be a letter, editorial or commentary, or a review of health economic evaluations. (Recent reviews will be ordered although not reviewed. The bibliographies will be checked for relevant studies, which will then be ordered.) • Unpublished reports will not be considered unless submitted as part of a call for evidence. • Studies must be in English.
Search strategy	A health economic study search will be undertaken using population-specific terms and a health economic study filter – see appendix B below. Databases searched: • Centre for Reviews and Dissemination NHS Economic Evaluations Database (NHS EED) – all years (closed to new records April 2015) • Centre for Reviews and Dissemination Health Technology Assessment database – all years (closed to new records March 2018) • International HTA database (INAHTA) – all years • Medline and Embase – from 2014 (due to NHS EED closure)
Review strategy	Studies not meeting any of the search criteria above will be excluded. Studies published before 2006 (including those included in the previous guideline), abstract-only studies and studies from non-OECD countries or the USA will also be excluded. Each remaining study will be assessed for applicability and methodological limitations using the NICE economic evaluation checklist which can be found in appendix H of Developing NICE guidelines: the manual (2014).[30] Studies published in 2006 or later that were included in the previous guideline will be reassessed for inclusion and may be included or selectively excluded based on their relevance to the questions covered in this update and whether more applicable evidence is also identified. **Inclusion and exclusion criteria**

	• If a study is rated as both 'Directly applicable' and with 'Minor limitations' then it will be included in the guideline. A health economic evidence table will be completed and it will be included in the health economic evidence profile. • If a study is rated as either 'Not applicable' or with 'Very serious limitations' then it will usually be excluded from the guideline. If it is excluded then a health economic evidence table will not be completed and it will not be included in the health economic evidence profile. • If a study is rated as 'Partially applicable', with 'Potentially serious limitations' or both then there is discretion over whether it should be included. **Where there is discretion** The health economist will make a decision based on the relative applicability and quality of the available evidence for that question, in discussion with the guideline committee if required. The ultimate aim is to include health economic studies that are helpful for decision-making in the context of the guideline and the current NHS setting. If several studies are considered of sufficiently high applicability and methodological quality that they could all be included, then the health economist, in discussion with the committee if required, may decide to include only the most applicable studies and to selectively exclude the remaining studies. All studies excluded on the basis of applicability or methodological limitations will be listed with explanation in the excluded health economic studies appendix below. The health economist will be guided by the following hierarchies. *Setting:* • UK NHS (most applicable). • OECD countries with predominantly public health insurance systems (for example, France, Germany, Sweden). • OECD countries with predominantly private health insurance systems (for example, Switzerland). • Studies set in non-OECD countries or in the USA will be excluded before being assessed for applicability and methodological limitations. *Health economic study type:* • Cost–utility analysis (most applicable). • Other type of full economic evaluation (cost–benefit analysis, cost-effectiveness analysis, cost–consequences analysis). • Comparative cost analysis. • Non-comparative cost analyses including cost-of-illness studies will be excluded before being assessed for applicability and methodological limitations.

	Year of analysis: • The more recent the study, the more applicable it will be. • Studies published in 2006 or later (including any such studies included in the previous guideline) but that depend on unit costs and resource data entirely or predominantly from before 2006 will be rated as 'Not applicable'. • Studies published before 2006 (including any such studies included in the previous guideline) will be excluded before being assessed for applicability and methodological limitations. *Quality and relevance of effectiveness data used in the health economic analysis:* • The more closely the clinical effectiveness data used in the health economic analysis match with the outcomes of the studies included in the clinical review the more useful the analysis will be for decision-making in the guideline.

Appendix B – Literature search strategies

B.1 Clinical search literature search strategy

Searches were constructed using a PICO framework where population (P) terms were combined with Intervention (I) and in some cases Comparison (C) terms. Outcomes (O) are rarely used in search strategies as these concepts may not be indexed or described in the title or abstract and are therefore difficult to retrieve. Search filters were applied to the search where appropriate.

Table 12: Database parameters, filters and limits applied

Database	Dates searched	Search filter used
Medline (OVID)	1946 – 08 January 2023	Randomised controlled trials Systematic review studies English language
Embase (OVID)	1974 – 08 January 2023	Randomised controlled trials Systematic review studies English language
The Cochrane Library (Wiley)	Cochrane Reviews to 2023 Issue 1 of 12 CENTRAL to 2023 Issue 1 of 12	
Epistemonikos (The Epistemonikos Foundation)	Inception – 08 January 2023	Exclusions (Cochrane reviews) English language
AMED, Allied and Complementary Medicine (OVID)	Inception – 08 January 2023	Randomised controlled trials Systematic review studies Exclusions (animal studies, letters, comments, case reports) English language

Medline (Ovid) search terms

1.	exp aphasia/
2.	language disorder/ or speech disorder/ or anomia/
3.	(aphasi* or dysphasi* or anomia or anomic).ti,ab,kf.
4.	((language* or speech or speak* or writ* or communicat* or voic* or articulat* or linguistic*) adj5 (disorder* or impair* or problem* or dysfunction)).ti,ab,kf.
5.	or/1-4
6.	language therapy/ or speech therapy/
7.	speech-language pathology/
8.	remedial therap*.ti,ab,kf.

9.	((language* or speech or speak* or writ* or communicat* or voic* or articulat* or linguistic* or aphasi* or dysphasi* or anomia or anomic or phonolog*) adj5 (therap* or treatment* or training or tool or tools or rehab* or remediat* or intervention*)).ti,ab,kf.
10.	(computer* or digital or digiti?e* or online or app or apps or software).ti,ab,kf.
11.	(StepbyStep or TACTUS or iRead or "read-write" or "constant therapy" or ORLA or "oral reading for language" or EVAPark or "ReadySpeech").ti,ab,kf.
12.	or/6-11
13.	5 and 12
14.	Limit 13 to English language
15.	randomized controlled trial.pt.
16.	controlled clinical trial.pt.
17.	randomi#ed.ti,ab.
18.	placebo.ab.
19.	randomly.ti,ab.
20.	Clinical Trials as topic.sh.
21.	trial.ti.
22.	or/14-20
23.	Meta-Analysis/
24.	exp Meta-Analysis as Topic/
25.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
26.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
27.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
28.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
29.	(search* adj4 literature).ab.
30.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
31.	cochrane.jw.
32.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
33.	or/22-31
34.	14 and (22 or 33)

Embase (Ovid) search terms

1.	*aphasia/
2.	*language disability/ or *speech disorder/ or *anomia/
3.	(aphasi* or dysphasi* or anomia or anomic).ti,ab,kf.
4.	((language* or speech or speak* or writ* or communicat* or voic* or articulat* or linguistic*) adj5 (disorder* or impair* or problem* or dysfunction)).ti,ab,kf.
5.	or/1-4
6.	*language therapy/ or *speech therapy/
7.	remedial therap*.ti,ab,kf.
8.	((language* or speech or speak* or writ* or communicat* or voic* or articulat* or linguistic* or aphasi* or dysphasi* or anomia or anomic or phonolog*) adj5 (therap* or treatment* or training or tool or tools or rehab* or remediat* or intervention*)).ti,ab,kf.
9.	(computer* or digital or digiti?e* or online or app or apps or software).ti,ab,kf.

10.	(StepbyStep or TACTUS or iRead or "read-write" or "constant therapy" or ORLA or "oral reading for language" or EVAPark or "ReadySpeech").ti,ab,kf.
11.	or/6-10
12.	5 and 11
13.	Limit 12 to English language
14.	random*.ti,ab.
15.	factorial*.ti,ab.
16.	(crossover* or cross over*).ti,ab.
17.	((doubl* or singl*) adj blind*).ti,ab.
18.	(assign* or allocat* or volunteer* or placebo*).ti,ab.
19.	crossover procedure/
20.	single blind procedure/
21.	randomized controlled trial/
22.	double blind procedure/
23.	or/13-21
24.	systematic review/
25.	meta-analysis/
26.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
27.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
28.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
29.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
30.	(search* adj4 literature).ab.
31.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
32.	cochrane.jw.
33.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
34.	or/42-51
35.	13 and (23 or 34)

1 **Cochrane Library (Wiley) search terms**

#1.	MeSH descriptor: [Aphasia] explode all trees
#2.	MeSH descriptor: [Language Disorders] explode all trees
#3.	MeSH descriptor: [Speech Disorders] explode all trees
#4.	MeSH descriptor: [Anomia] explode all trees
#5.	(aphasi* or dysphasi* or anomia or anomic):ti,ab
#6.	((language* or speech or speak* or writ* or communicat* or voic* or articulat* or linguistic*) near/5 (disorder* or impair* or problem* or dysfunction)):ti,ab
#7.	(or #1-#6)
#8.	MeSH descriptor: [Language Therapy] explode all trees
#9.	MeSH descriptor: [Speech Therapy] explode all trees
#10.	MeSH descriptor: [Speech-Language Pathology] explode all trees
#11.	remedial therap*:ti,ab
#12.	((language* or speech or speak* or writ* or communicat* or voic* or articulat* or linguistic* or aphasi* or dysphasi* or anomia or anomic or phonolog*) near/5 (therap* or treatment* or training or tool or tools or rehab* or remediat* or intervention*)):ti,ab

#13.	(computer* or digital or digiti?e* or online or app or apps or software):ti,ab
#14.	(StepbyStep or TACTUS or iRead or "read-write" or "constant therapy" or ORLA or "oral reading for language" or EVAPark or "ReadySpeech"):ti,ab
#15.	(or #8-#14)
#16.	#7 and #15

AMED search terms

1.	exp aphasia/
2.	language disorder/ or speech disorder/ or anomia/
3.	(aphasi* or dysphasi* or anomia or anomic).ti,ab.
4.	((language* or speech or speak* or writ* or communicat* or voic* or articulat* or linguistic*) adj5 (disorder* or impair* or problem* or dysfunction)).ti,ab.
5.	or/1-4
6.	language therapy/ or speech therapy/
7.	speech-language pathology/
8.	remedial therap*.ti,ab.
9.	((language* or speech or speak* or writ* or communicat* or voic* or articulat* or linguistic* or aphasi* or dysphasi* or anomia or anomic or phonolog*) adj5 (therap* or treatment* or training or tool or tools or rehab* or remediat* or intervention*)).ti,ab.
10.	(computer* or digital or digiti?e* or online or app or apps or software).ti,ab.
11.	(StepbyStep or TACTUS or iRead or "read-write" or "constant therapy" or ORLA or "oral reading for language" or EVAPark or "ReadySpeech").ti,ab.
12.	or/6-11
13.	5 and 12
14.	case report/
15.	(letter or comment*).ti.
16.	or/14-15
17.	randomized controlled trials/ or random*.ti,ab.
18.	16 not 17
19.	animals/ not humans/
20.	(rat or rats or mouse or mice or rodent*).ti.
21.	or/18-20
22.	13 not 21
23.	randomized controlled trials/
24.	randomized controlled trial.pt.
25.	controlled clinical trial.pt.
26.	placebo.ab.
27.	random*.ti,ab.
28.	trial.ti,ab.
29.	groups.ab.
30.	or/23-29
31.	Meta-Analysis/
32.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
33.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
34.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.

35.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
36.	(search* adj4 literature).ab.
37.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
38.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
39.	or/31-38
40.	30 or 39
41.	22 and 40
42.	Limit 41 to English language

Epistemonikos search terms

1.	(title:((title:(((language* OR speech OR speak* OR writ* OR communicat* OR voic* OR articulat* OR linguistic*) N5 (disorder* OR impair* OR problem* OR dysfunction))) OR abstract:(((language* OR speech OR speak* OR writ* OR communicat* OR voic* OR articulat* OR linguistic*) N5 (disorder* OR impair* OR problem* OR dysfunction)))) OR (title:((aphasi* OR dysphasi* OR anomia OR anomic)) OR abstract:((aphasi* OR dysphasi* OR anomia OR anomic)))) OR abstract:((title:(((language* OR speech OR speak* OR writ* OR communicat* OR voic* OR articulat* OR linguistic*) N5 (disorder* OR impair* OR problem* OR dysfunction))) OR abstract:(((language* OR speech OR speak* OR writ* OR communicat* OR voic* OR articulat* OR linguistic*) N5 (disorder* OR impair* OR problem* OR dysfunction)))) OR (title:((aphasi* OR dysphasi* OR anomia OR anomic)) OR abstract:((aphasi* OR dysphasi* OR anomia OR anomic))))) AND (title:((title:(((language* OR speech OR speak* OR writ* OR communicat* OR voic* OR articulat* OR linguistic* OR aphasi* OR dysphasi* OR anomia OR anomic OR phonolog*) N5 (therap* OR treatment* OR training OR tool OR tools OR rehab* OR remediat* OR intervention*))) OR abstract:(((language* OR speech OR speak* OR writ* OR communicat* OR voic* OR articulat* OR linguistic* OR aphasi* OR dysphasi* OR anomia OR anomic OR phonolog*) N5 (therap* OR treatment* OR training OR tool OR tools OR rehab* OR remediat* OR intervention*)))) OR (title:((computer* OR digital OR digiti?e* OR online OR app OR apps OR software)) OR abstract:((computer* OR digital OR digiti?e* OR online OR app OR apps OR software))) OR (title:((StepbyStep OR TACTUS OR iRead OR "read-write" OR "constant therapy" ORLA OR "oral reading for language" OR EVAPark OR "ReadySpeech")) OR abstract:((StepbyStep OR TACTUS OR iRead OR "read-write" OR "constant therapy" ORLA OR "oral reading for language" OR EVAPark OR "ReadySpeech")))) OR abstract:((title:(((language* OR speech OR speak* OR writ* OR communicat* OR voic* OR articulat* OR linguistic* OR aphasi* OR dysphasi* OR anomia OR anomic OR phonolog*) N5 (therap* OR treatment* OR training OR tool OR tools OR rehab* OR remediat* OR intervention*))) OR abstract:(((language* OR speech OR speak* OR writ* OR communicat* OR voic* OR articulat* OR linguistic* OR aphasi* OR dysphasi* OR anomia OR anomic OR phonolog*) N5 (therap* OR treatment* OR training OR tool OR tools OR rehab* OR remediat* OR intervention*)))) OR (title:((computer* OR digital OR digiti?e* OR online OR app OR apps OR software)) OR abstract:((computer* OR digital OR digiti?e* OR online OR app OR apps OR software))) OR (title:((StepbyStep OR TACTUS OR iRead OR "read-write" OR "constant therapy" ORLA OR "oral reading for language" OR EVAPark OR "ReadySpeech")) OR abstract:((StepbyStep OR TACTUS OR iRead OR "read-write" OR "constant therapy" ORLA OR "oral reading for language" OR EVAPark OR "ReadySpeech")))))

B.2 Health Economics literature search strategy

Health economic evidence was identified by conducting searches using terms for a broad Stroke Rehabilitation population. The following databases were searched: NHS Economic Evaluation Database (NHS EED - this ceased to be updated after 31st March 2015), Health Technology Assessment database (HTA - this ceased to be updated from 31st March 2018) and The International Network of Agencies for Health Technology Assessment (INAHTA). Searches for recent evidence were run on Medline and Embase from 2014 onwards for health economics, and all years for quality-of-life studies. Additional searches were run in CINAHL and PsycInfo looking for health economic evidence.

Table 2: Database parameters, filters and limits applied

Database	Dates searched	Search filters and limits applied
Medline (OVID)	Health Economics 1 January 2014 – 08 January 2023 Quality of Life 1946 – 08 January 2023	Health economics studies Quality of life studies Exclusions (animal studies, letters, comments, editorials, case studies/reports,) English language
Embase (OVID)	Health Economics 1 January 2014 – 08 January 2023 Quality of Life 1974 – 08 January 2023	Health economics studies Quality of life studies Exclusions (animal studies, letters, comments, editorials, case studies/reports, conference abstracts) English language
NHS Economic Evaluation Database (NHS EED) (Centre for Research and Dissemination - CRD)	Inception –31st March 2015	
Health Technology Assessment Database (HTA) (Centre for Research and Dissemination – CRD)	Inception – 31st March 2018	
The International Network of Agencies for Health Technology Assessment (INAHTA)	Inception - 08 January 2023	English language
PsycINFO (OVID)	1 January 2014 – 08 January 2023	Health economics studies Exclusions (animal studies, letters, case reports) Human English language
Current Nursing and Allied Health Literature - CINAHL (EBSCO)	1 January 2014 – 08 January 2023	Health economics studies Exclusions (Medline records, animal studies, letters, editorials, comments, theses)

Database	Dates searched	Search filters and limits applied
		Human English language

1 **Medline (Ovid) search terms**

1.	exp Stroke/
2.	exp Cerebral Hemorrhage/
3.	(stroke or strokes or cva or poststroke* or apoplexy or "cerebrovascular accident").ti,ab.
4.	((cerebro* or brain or brainstem or cerebral*) adj3 (infarct* or accident*)).ti,ab.
5.	"brain attack*".ti,ab.
6.	or/1-5
7.	letter/
8.	editorial/
9.	news/
10.	exp historical article/
11.	Anecdotes as Topic/
12.	comment/
13.	case report/
14.	(letter or comment*).ti.
15.	or/7-14
16.	randomized controlled trial/ or random*.ti,ab.
17.	15 not 16
18.	animals/ not humans/
19.	exp Animals, Laboratory/
20.	exp Animal Experimentation/
21.	exp Models, Animal/
22.	exp Rodentia/
23.	(rat or rats or mouse or mice or rodent*).ti.
24.	or/17-23
25.	6 not 24
26.	Economics/
27.	Value of life/
28.	exp "Costs and Cost Analysis"/
29.	exp Economics, Hospital/
30.	exp Economics, Medical/
31.	Economics, Nursing/
32.	Economics, Pharmaceutical/
33.	exp "Fees and Charges"/
34.	exp Budgets/

35.	budget*.ti,ab.
36.	cost*.ti.
37.	(economic* or pharmaco?economic*).ti.
38.	(price* or pricing*).ti,ab.
39.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
40.	(financ* or fee or fees).ti,ab.
41.	(value adj2 (money or monetary)).ti,ab.
42.	or/26-41
43.	quality-adjusted life years/
44.	sickness impact profile/
45.	(quality adj2 (wellbeing or well being)).ti,ab.
46.	sickness impact profile.ti,ab.
47.	disability adjusted life.ti,ab.
48.	(qal* or qtime* or qwb* or daly*).ti,ab.
49.	(euroqol* or eq5d* or eq 5*).ti,ab.
50.	(qol* or hql* or hqol* or h qol* or hrqol* or hr qol*).ti,ab.
51.	(health utility* or utility score* or disutilit* or utility value*).ti,ab.
52.	(hui or hui1 or hui2 or hui3).ti,ab.
53.	(health* year* equivalent* or hye or hyes).ti,ab.
54.	discrete choice*.ti,ab.
55.	rosser.ti,ab.
56.	(willingness to pay or time tradeoff or time trade off or tto or standard gamble*).ti,ab.
57.	(sf36* or sf 36* or short form 36* or shortform 36* or shortform36*).ti,ab.
58.	(sf20 or sf 20 or short form 20 or shortform 20 or shortform20).ti,ab.
59.	(sf12* or sf 12* or short form 12* or shortform 12* or shortform12*).ti,ab.
60.	(sf8* or sf 8* or short form 8* or shortform 8* or shortform8*).ti,ab.
61.	(sf6* or sf 6* or short form 6* or shortform 6* or shortform6*).ti,ab.
62.	or/43-61
63.	25 and 42
64.	25 and 62
65.	limit 63 to English language
66.	limit 64 to English language

Embase (Ovid) search terms

1.	exp Cerebrovascular accident/
2.	exp Brain infarction/
3.	(stroke or strokes or cva or poststroke* or apoplexy or "cerebrovascular accident").ti,ab.
4.	((cerebro* or brain or brainstem or cerebral*) adj3 (infarct* or accident*)).ti,ab.
5.	"brain attack*".ti,ab.

6.	Intracerebral hemorrhage/
7.	or/1-6
8.	letter.pt. or letter/
9.	note.pt.
10.	editorial.pt.
11.	case report/ or case study/
12.	(letter or comment*).ti.
13.	or/8-12
14.	randomized controlled trial/ or random*.ti,ab.
15.	13 not 14
16.	animal/ not human/
17.	nonhuman/
18.	exp Animal Experiment/
19.	exp Experimental Animal/
20.	animal model/
21.	exp Rodent/
22.	(rat or rats or mouse or mice).ti.
23.	or/15-22
24.	7 not 23
25.	health economics/
26.	exp economic evaluation/
27.	exp health care cost/
28.	exp fee/
29.	budget/
30.	funding/
31.	budget*.ti,ab.
32.	cost*.ti.
33.	(economic* or pharmaco?economic*).ti.
34.	(price* or pricing*).ti,ab.
35.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
36.	(financ* or fee or fees).ti,ab.
37.	(value adj2 (money or monetary)).ti,ab.
38.	or/25-37
39.	quality adjusted life year/
40.	"quality of life index"/
41.	short form 12/ or short form 20/ or short form 36/ or short form 8/
42.	sickness impact profile/
43.	(quality adj2 (wellbeing or well being)).ti,ab.
44.	sickness impact profile.ti,ab.
45.	disability adjusted life.ti,ab.
46.	(qal* or qtime* or qwb* or daly*).ti,ab.

47.	(euroqol* or eq5d* or eq 5*).ti,ab.
48.	(qol* or hql* or hqol* or h qol* or hrqol* or hr qol*).ti,ab.
49.	(health utility* or utility score* or disutilit* or utility value*).ti,ab.
50.	(hui or hui1 or hui2 or hui3).ti,ab.
51.	(health* year* equivalent* or hye or hyes).ti,ab.
52.	discrete choice*.ti,ab.
53.	rosser.ti,ab.
54.	(willingness to pay or time tradeoff or time trade off or tto or standard gamble*).ti,ab.
55.	(sf36* or sf 36* or short form 36* or shortform 36* or shortform36*).ti,ab.
56.	(sf20 or sf 20 or short form 20 or shortform 20 or shortform20).ti,ab.
57.	(sf12* or sf 12* or short form 12* or shortform 12* or shortform12*).ti,ab.
58.	(sf8* or sf 8* or short form 8* or shortform 8* or shortform8*).ti,ab.
59.	(sf6* or sf 6* or short form 6* or shortform 6* or shortform6*).ti,ab.
60.	or/39-59
61.	limit 24 to English language
62.	38 and 61
63.	60 and 61

NHS EED and HTA (CRD) search terms

#1.	MeSH DESCRIPTOR Stroke EXPLODE ALL TREES
#2.	MeSH DESCRIPTOR Cerebral Hemorrhage EXPLODE ALL TREES
#3.	(stroke* or cva or poststroke* or apoplexy or "cerebrovascular accident")
#4.	(((cerebro* or brain or brainstem or cerebral*) adj3 (infarct* or accident*)))
#5.	("brain attack*")
#6.	#1 OR #2 OR #3 OR #4 OR #5

INAHTA search terms

1.	(brain attack*) OR (((cerebro* or brain or brainstem or cerebral*) and (infarct* or accident*))) OR ((stroke or strokes or cva or poststroke* or apoplexy or "cerebrovascular accident")) OR ("Cerebral Hemorrhage"[mhe]) OR ("Stroke"[mhe])

CINAHL search terms

1.	MH "Economics+"
2.	MH "Financial Management+"
3.	MH "Financial Support+"
4.	MH "Financing, Organized+"
5.	MH "Business+"
6.	S2 OR S3 or S4 OR S5
7.	S1 not S6
8.	MH "Health Resource Allocation"
9.	MH "Health Resource Utilization"
10.	S8 OR S9
11.	S7 OR S10
12.	(cost or costs or economic* or pharmacoeconomic* or price* or pricing*) OR AB (cost or costs or economic* or pharmacoeconomic* or price* or pricing*)

13.	S11 OR S12
14.	PT editorial
15.	PT letter
16.	PT commentary
17.	S14 or S15 or S16
18.	S13 NOT S17
19.	MH "Animal Studies"
20.	(ZT "doctoral dissertation") or (ZT "masters thesis")
21.	S18 NOT (S19 OR S20)
22.	PY 2014-
23.	S21 AND S22
24.	MW Stroke or MH Cerebral Hemorrhage
25.	stroke* or cva or poststroke* or apoplexy or "cerebrovascular accident"
26.	(cerebro* OR brain OR brainstem OR cerebral*) AND (infarct* OR accident*)
27.	"brain attack*"
28.	S24 OR S25 OR S26 OR S27
29.	S23 AND S28

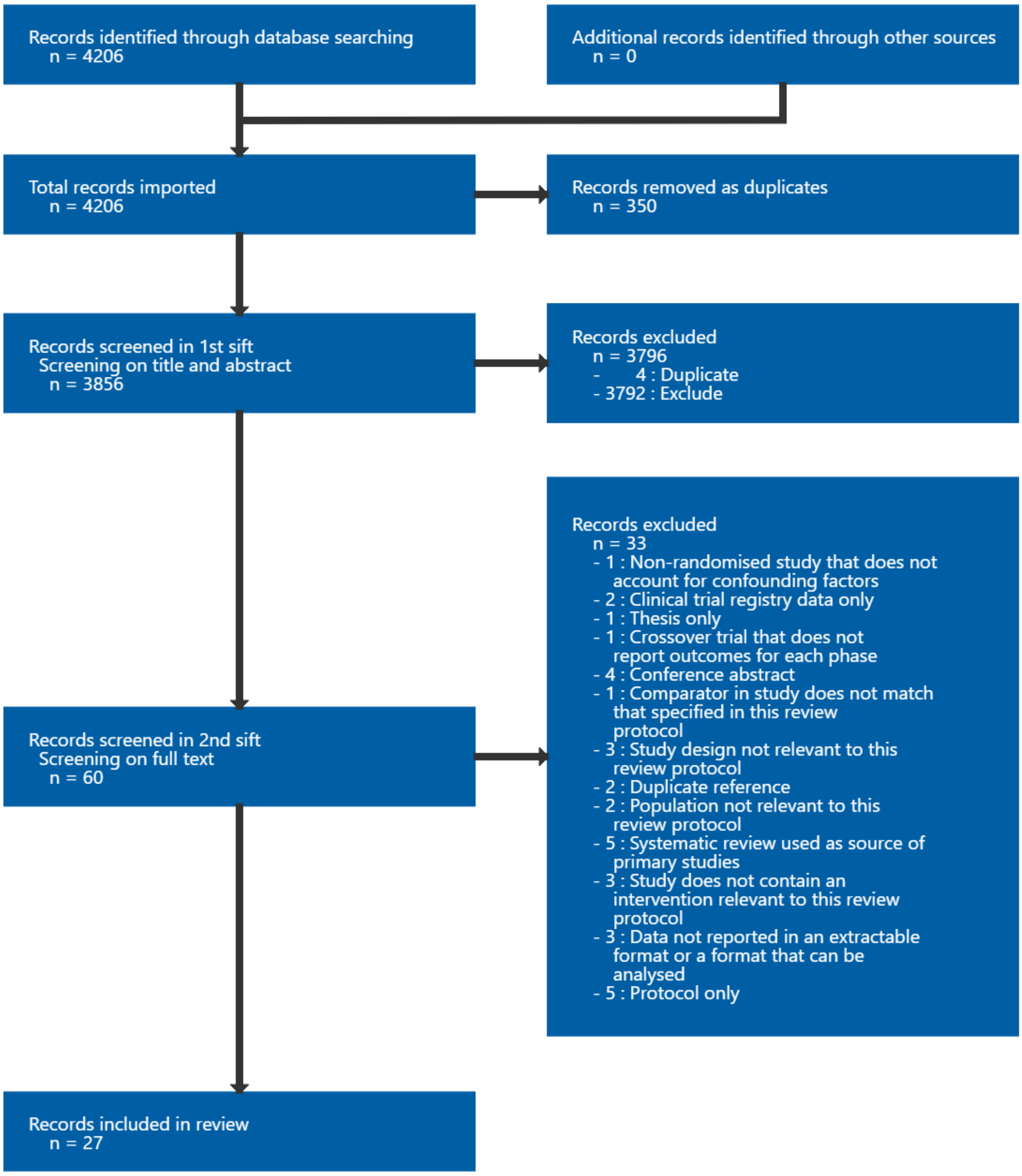
1 **PsycINFO search terms**

1.	exp Stroke/
2.	exp Cerebral hemorrhage/
3.	(stroke or strokes or cva or poststroke* or apoplexy or "cerebrovascular accident").ti,ab.
4.	((cerebro* or brain or brainstem or cerebral*) adj3 (infarct* or accident*)).ti,ab.
5.	"brain attack*".ti,ab.
6.	Cerebrovascular accidents/
7.	exp Brain damage/
8.	(brain adj2 injur*).ti.
9.	or/1-8
10.	Letter/
11.	Case report/
12.	exp Rodents/
13.	or/10-12
14.	9 not 13
15.	limit 14 to (human and english language)
16.	First posting.ps.
17.	15 and 16
18.	15 or 17
19	"costs and cost analysis"/
20.	"Cost Containment"/
21.	(economic adj2 evaluation$).ti,ab.
22.	(economic adj2 analy$).ti,ab.

23.	(economic adj2 (study or studies)).ti,ab.
24.	(cost adj2 evaluation$).ti,ab.
25.	(cost adj2 analy$).ti,ab.
26.	(cost adj2 (study or studies)).ti,ab.
27.	(cost adj2 effective$).ti,ab.
28.	(cost adj2 benefit$).ti,ab.
29.	(cost adj2 utili$).ti,ab.
30.	(cost adj2 minimi$).ti,ab.
31.	(cost adj2 consequence$).ti,ab.
32.	(cost adj2 comparison$).ti,ab.
33.	(cost adj2 identificat$).ti,ab.
34.	(pharmacoeconomic$ or pharmaco-economic$).ti,ab.
35.	or/19-34
36.	(0003-4819 or 0003-9926 or 0959-8146 or 0098-7484 or 0140-6736 or 0028-4793 or 1469-493X).is.
37.	35 not 36
38.	18 and 37

Appendix C – Effectiveness evidence study selection

Figure 1: Flow chart of clinical study selection for the review of computer-based tools for speech and language therapy



Appendix D – Effectiveness evidence

Braley, 2021

Bibliographic Reference	Braley, M.; Pierce, J. S.; Saxena, S.; De Oliveira, E.; Taraboanta, L.; Anantha, V.; Lakhan, S. E.; Kiran, S.; A Virtual, Randomized, Control Trial of a Digital Therapeutic for Speech, Language, and Cognitive Intervention in Post-stroke Persons With Aphasia; Frontiers in neurology [electronic resource].; 2021; vol. 12; 626780

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	Clinicaltrials.gov = NCT04488029
Study type	Randomised controlled trial (RCT)
Study location	United States and Canada
Study setting	Home-based
Study dates	March 2019 to November 2019
Sources of funding	This study was funded by The Learning Corp, Newton, M.A. The Learning Corp is now called Constant Therapy Health.

Inclusion criteria	Diagnosis of stroke involving haemorrhage or ischaemic event, resulting in speech, language, and/or cognitive deficits as confirmed by medical records; time post-stroke of at least 4 months prior to enrollment; having been discharged from the hospital or rehabilitation center; being aged 18 years or older at the time of consent; being a fluent English speaker prior to stroke; having confirmed aphasia based on the Western Aphasia Battery, Revised (WAB-R) Aphasia Quotient with a score of 90 or lower (normal cutoff score is 93.8); the presence of a family member or caregiver willing and able to provide assistance during the duration of the study period.
Exclusion criteria	Comorbid neurological conditions that could impair study performance in the opinion of research staff (either a certified Speech-Language Pathologist or a trained Research Assistant); requiring inpatient care or acute care at the time of the study; concurrently undergoing one-on-one individual therapy at a hospital or rehabilitation facility, university, or at home; presence of severe apraxia of speech or severe dysarthria of speech based on clinical screening; comorbid psychiatric conditions that could impair study participation in the opinion of study staff; uncorrected vision or hearing loss impairing study participation.
Recruitment / selection of participants	Recruitment was conducted through: consumers who had downloaded the commercially available Constant Therapy app but not signed up for an account; social media groups focused on recovery from aphasia; referrals from speech and language pathologists who had discharged clients from their service. This was conducted via email, video advertising, flyers and social media posts.
Intervention(s)	Computer-based tools for speech and language therapy (Constant Therapy app) N=17 Provisioned tablet with the Constant Therapy app pre-installed using The NeuroPerformance Engine to optimise therapy through difficulty level. An initial homework schedule was used to assess initial WAB-R performance. The program algorithm then used a library of therapy exercises within the app. Across the exercises were over 100,000 stimuli within 350+ levels of difficulty spanning 9 different cognitive, speech and language domains. Participants were instructed to use the app for at least 30 minutes a day and at least 5 days a week. The app tracked usage of the program so this could be monitored. Concomitant therapy: No additional information.
Subgroup 1: Severity of communication	Not stated/unclear

difficulty (as stated by category)	
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	21-30 hours
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Word finding therapy
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=15 A regime of standard, paper workbooks used for homework practice. The progression of homework went from Workbook for Aphasia to Speech Therapy Aphasia Rehabilitation Workbooks or the Workbook of Activities for Language and Cognition based on feedback about difficulty. People were instructed to complete at least 1 exercise within the workbook at least 5 days a week.

	Concomitant therapy: No additional information.
Number of participants	32
Duration of follow-up	12 weeks (end of intervention is 10 weeks)
Indirectness	No additional information.
Additional comments	No additional information.

Study arms

Computer-based tools for speech and language therapy (Constant Therapy app) (N = 17)

Provisioned tablet with the Constant Therapy app pre-installed using The NeuroPerformance Engine to optimise therapy through difficulty level. An initial homework schedule was used to assess initial WAB-R performance. The program algorithm then used a library of therapy exercises within the app. Across the exercises were over 100,000 stimuli within 350+ levels of difficulty spanning 9 different cognitive, speech and language domains. Participants were instructed to use the app for at least 30 minutes a day and at least 5 days a week. The app tracked usage of the program so this could be monitored. Concomitant therapy: No additional information.

Speech and language therapy without computer-based tools (usual care) (N = 15)

A regime of standard, paper workbooks used for homework practice. The progression of homework went from Workbook for Aphasia to Speech Therapy Aphasia Rehabilitation Workbooks or the Workbook of Activities for Language and Cognition based on feedback about difficulty. People were instructed to complete at least 1 exercise within the workbook at least 5 days a week. Concomitant therapy: No additional information.

1 **Characteristics**

2 ***Arm-level characteristics***

Characteristic	Computer-based tools for speech and language therapy (Constant Therapy app) (N = 17)	Speech and language therapy without computer-based tools (usual care) (N = 15)
% Female Sample size	n = 7 ; % = 41	n = 7 ; % = 47
Mean age (SD) (years) Mean (SD)	58.9 (10)	64.2 (9.9)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (Months) Mean (SD)	53 (56)	38.1 (32)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA
Aphasia All inferred to fulfil this criteria from the inclusion criteria	n = 17 ; % = 100	n = 15 ; % = 100

Characteristic	Computer-based tools for speech and language therapy (Constant Therapy app) (N = 17)	Speech and language therapy without computer-based tools (usual care) (N = 15)
Sample size		

Outcomes

Study timepoints
- Baseline
- 12 week (≥3 months)

Continuous outcomes (communication - overall language ability)

Outcome	Computer-based tools for speech and language therapy (Constant Therapy app), Baseline, N = 17	Computer-based tools for speech and language therapy (Constant Therapy app), 12 week, N = 17	Speech and language therapy without computer-based tools (usual care), Baseline, N = 15	Speech and language therapy without computer-based tools (usual care), 12 week, N = 15
Communication - Overall language ability (Western Aphasia Battery, Revised) Scale range: 0-100. Change scores calculated from individual patient data. Mean (SD)	61.62 (24.28)	6.75 (6.16)	66.02 (19.08)	0.38 (5.47)

Communication - Overall language ability (Western Aphasia Battery, Revised) - Polarity - Higher values are better

Continuous outcome (communication related quality of life)

Outcome	Computer-based tools for speech and language therapy (Constant Therapy app), Baseline, N = 17	Computer-based tools for speech and language therapy (Constant Therapy app), 12 week, N = 17	Speech and language therapy without computer-based tools (usual care), Baseline, N = 15	Speech and language therapy without computer-based tools (usual care), 12 week, N = 13
Communication related quality of life (Stroke and Aphasia Quality of Life Scale-39) Scale range: 0-10. Change scores calculated from individual patient data. Mean (SD)	3.53 (0.54)	0.24 (0.36)	3.57 (0.58)	0.11 (0.4)

Communication related quality of life (Stroke and Aphasia Quality of Life Scale-39) - Polarity - Higher values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-Overalllanguageability(WesternAphasiaBattery,Revised)-MeanSD-Computer-based tools for speech and language therapy (Constant Therapy app)-Speech and language therapy without computer-based tools (usual care)-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcome(communicationrelatedqualityoflife)-Communicationrelatedqualityoflife(StrokeandAphasiaQualityofLifeScale-39)-MeanSD-Computer-based tools for speech and language therapy (Constant Therapy app)-Speech and language therapy without computer-based tools (usual care)-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Caute, 2019

Bibliographic Reference	Caute, A.; Woolf, C.; Wilson, S.; Stokes, C.; Monnelly, K.; Cruice, M.; Bacon, K.; Marshall, J.; Technology-Enhanced Reading Therapy for People With Aphasia: Findings From a Quasirandomized Waitlist Controlled Study; Journal of Speech Language & Hearing Research; 2019; vol. 62 (no. 12); 4382-4416

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.

Study type	Quasi- randomised controlled trial
Study location	United Kingdom
Study setting	Most people were treated in a University clinic, two were treated in their own home and one at a community centre.
Study dates	No additional information.
Sources of funding	This study was funded by The Barts Charity, Grant code: MGU0243 awarded to Jane MArshall and Celia Woolf.
Inclusion criteria	Aphasia following stroke; at least four-months post-onset and medically stable; fluent in English before their stroke (first or second language users); identified reading as a priority for intervention and had functional reading goals.
Exclusion criteria	Severely impaired condition; secondary cognitive diagnosis, such as dementia; reading and auditory comprehension were severely impaired; receiving any other speech and language therapy during their involvement in the project.
Recruitment / selection of participants	Recruited from a number of sources including the ethically-approved City University aphasia recruitment database, referrals from speech and language therapists, patient/family enquiries via email, and from stroke association groups.
Intervention(s)	Computer based tools for speech and language therapy (Claro Software) N=11 1-2 hours of technology set-up training, immediately followed by 12 one-hour therapy sessions delivered over 6 weeks (2 sessions per week). Treatment was conducted face to face. Half of the sessions were delivered by students of speech and language therapy. Two assistive technologies were used, with a view to support people with a range of aphasic profiles and reading goals (Claro Software and Amazon's Fire 7 Tablet). During therapy people with less severe reading impairments and whose goals included reading books were encouraged to use the Fire Tablet, while people with more severe reading impairments or were already familiar with using a computer used Claro Software. Goals were set before therapy took place. The further 12 hours of therapy involved troubleshooting any technology issues, reviewing the reading completed since the previous session, active reading during the session with support for reading comprehension and technology use and setting reading goals for the next session. People were encouraged to read at home between sessions for at least 20 minutes a day. Concomitant therapy: No additional information.
Subgroup 1: Severity of	Not stated/unclear

communication difficulty (as stated by category)	
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	11-20 hours
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	In person delivery
Subgroup 6: Method of therapy	Reading therapy
Population subgroups	No additional information
Comparator	No treatment N=10 Waiting list control. Concomitant therapy: No additional information.

Number of participants	23
Duration of follow-up	6 weeks (only the first follow up period recorded in the study is relevant to the review, as after 6 weeks the waiting list group received the treatment).
Indirectness	No additional information.
Additional comments	ITT (no dropouts).

Study arms

Computer based tools for speech and language therapy (Claro Software) (N = 11)

1-2 hours of technology set-up training, immediately followed by 12 one-hour therapy sessions delivered over 6 weeks (2 sessions per week). Treatment was conducted face to face. Half of the sessions were delivered by students of speech and language therapy. Two assistive technologies were used, with a view to support people with a range of aphasic profiles and reading goals (Claro Software and Amazon's Fire 7 Tablet). During therapy people with less severe reading impairments and whose goals included reading books were encouraged to use the Fire Tablet, while people with more severe reading impairments or were already familiar with using a computer used Claro Software. Goals were set before therapy took place. The further 12 hours of therapy involved troubleshooting any technology issues, reviewing the reading completed since the previous session, active reading during the session with support for reading comprehension and technology use and setting reading goals for the next session. People were encouraged to read at home between sessions for at least 20 minutes a day. Concomitant therapy: No additional information.

No treatment (N = 10)

Waiting list control. Concomitant therapy: No additional information.

1 **Characteristics**

2 ***Arm-level characteristics***

Characteristic	Computer based tools for speech and language therapy (Claro Software) (N = 11)	No treatment (N = 10)
% Female Sample size	n = 3 ; % = 27	n = 4 ; % = 40
Mean age (SD) (years) Mean (SD)	55.4 (10.5)	56.2 (13.9)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity CAT Screening Score (severity categories not provided, but mean scores available) Mean (SD)	123.18 (39.32)	140.44 (23.15)
Time after stroke (Months) Mean (SD)	73.9 (53.5)	47 (36.35)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA
Aphasia	n = 11 ; % = 100	n = 10 ; % = 100

Characteristic	Computer based tools for speech and language therapy (Claro Software) (N = 11)	No treatment (N = 10)
Sample size		

Outcomes

Study timepoints

- Baseline
- 6 week (<3 months)

Continuous outcomes

Outcome	Computer based tools for speech and language therapy (Claro Software), Baseline, N = 11	Computer based tools for speech and language therapy (Claro Software), 6 week, N = 11	No treatment, Baseline, N = 10	No treatment, 6 week, N = 10
Communication - Impairment specific measures, reading (Reading Comprehension Battery for Aphasia subtests 7-9) Scale range: 0-30. Final values. Mean (SD)	19.55 (8.69)	20.27 (7.9)	19.8 (7.86)	19.8 (7.35)
Functional communication (Communication Activities of Daily Living Revised) Scale range: 0-100. Final values. Mean (SD)	77.82 (14.69)	79.09 (23.11)	83.6 (6.93)	88.2 (6.46)

Outcome	Computer based tools for speech and language therapy (Claro Software), Baseline, N = 11	Computer based tools for speech and language therapy (Claro Software), 6 week, N = 11	No treatment, Baseline, N = 10	No treatment, 6 week, N = 10
Psychological distress - depression (Visual Analog Mood Scales Revised Version [Sad]) Scale range: 0-100. Final values. Mean (SD)	50.27 (9.55)	56 (18.93)	52.3 (15.96)	55.7 (13.63)
Communication related quality of life (Assessment of Living with Aphasia) Scale range: 0-4. Final values. Mean (SD)	2.54 (0.7)	2.83 (0.61)	2.48 (0.58)	2.48 (0.74)

Communication - Impairment specific measures, reading (Reading Comprehension Battery for Aphasia subtests 7-9) - Polarity - Higher values are better

Functional communication (Communication Activities of Daily Living Revised) - Polarity - Higher values are better

Psychological distress - depression (Visual Analog Mood Scales Revised Version [Sad]) - Polarity - Higher values are better

Communication related quality of life (Assessment of Living with Aphasia) - Polarity - Higher values are better

Dichotomous outcome

Outcome	Computer based tools for speech and language therapy (Claro Software), Baseline, N = 11	Computer based tools for speech and language therapy (Claro Software), 6 week, N = 11	No treatment, Baseline, N = 10	No treatment, 6 week, N = 10
Discontinuation No of events	n = NA ; % = NA	n = 0 ; % = 0	n = NA ; % = NA	n = 0 ; % = 0

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-Impairmentspecificmeasures,reading(ReadingComprehensionBatteryforAphasiasubtests7-9)-MeanSD-Computer based tools for speech and language therapy (Claro Software)-No treatment-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Functionalcommunication(CommunicationActivitiesofDailyLivingRevised)-MeanSD-Computer based tools for speech and language therapy (Claro Software)-No treatment-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Psychologicaldistress-depression(VisualAnalogMoodScalesRevisedVersion[Sad])-MeanSD-Computer based tools for speech and language therapy (Claro Software)-No treatment-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communicationrelatedqualityoflife(AssessmentofLivingwithAphasia)-MeanSD-Computer based tools for speech and language therapy (Claro Software)-No treatment-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer based tools for speech and language therapy (Claro Software)-No treatment-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Cherney, 2010

Bibliographic Reference	Cherney, L. R.; Oral reading for language in aphasia (ORLA): evaluating the efficacy of computer-delivered therapy in chronic nonfluent aphasia; Topics in Stroke Rehabilitation; 2010; vol. 17 (no. 6); 423-31

Study details

Secondary publication of another included study- see primary study for details	No additional information.

Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)
Study location	United States of America
Study setting	Outpatient follow up
Study dates	No additional information.
Sources of funding	Supported by grants H133G060055 and H133G010098 from the National Institute on Disability and Rehabilitation Research, US Department of Education.
Inclusion criteria	Chronic aphasia (more than 12 months post onset); a single left-hemisphere stroke as determined by history and physician report; nonfluent aphasia; premorbidly right handed; at least a 12th-grade education; visual acuity no worse than 20/100 corrected in the better eye; auditory acuity no worse than 30 dB hearing loss at 500, 1000 and 2000 Hz, aided in the better ear.
Exclusion criteria	Global aphasia
Recruitment / selection of participants	No additional information.
Intervention(s)	Computer-based tools for speech and language therapy (ORLA treatment) N=11 ORLA treatment in the aphasia clinic, scheduled 2 to 3 times a week. First, people listened to a sentence twice while simultaneously looking at it written on an index card or on the computer screen; the second time, they also pointed to each word of the sentence. People then attempted to read the sentence aloud together with the computer voice and repeated this twice. For each sentence, they were asked to identify 2 or 3 randomly selected single words and then read each one aloud. Finally, people read the entire stimulus aloud again in unison with the therapist or computer voice. During an hour of

	treatment, people typically practiced 30 different stimuli of a specific length (3 to 5-word sentences, 8- to 12-word sentences, or 15- to 30-word brief paragraphs) predetermined by their language level. Concomitant therapy: No additional information.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	21-30 hours
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	In person delivery
Subgroup 6: Method of therapy	Reading therapy
Population subgroups	No additional information.

Comparator	Speech and language therapy without computer-based tools (usual care) N=14 Same therapy delivered by a therapist instead. Concomitant therapy: No additional information.
Number of participants	25
Duration of follow-up	12 weeks (end of intervention).
Indirectness	No additional information.
Additional comments	Method of analysis not clear

Study arms

Computer-based tools for speech and language therapy (ORLA treatment) (N = 11)

ORLA treatment in the aphasia clinic, scheduled 2 to 3 times a week. First, people listened to a sentence twice while simultaneously looking at it written on an index card or on the computer screen; the second time, they also pointed to each word of the sentence. People then attempted to read the sentence aloud together with the computer voice and repeated this twice. For each sentence, they were asked to identify 2 or 3 randomly selected single words and then read each one aloud. Finally, people read the entire stimulus aloud again in unison with the therapist or computer voice. During an hour of treatment, people typically practiced 30 different stimuli of a specific length (3 to 5-word sentences, 8- to 12-word sentences, or 15- to 30-word brief paragraphs) predetermined by their language level. Concomitant therapy: No additional information.

Speech and language therapy without computer-based tools (usual care) (N = 14)

Same therapy delivered by a therapist instead. Concomitant therapy: No additional information.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (ORLA treatment) (N = 11)	Speech and language therapy without computer-based tools (usual care) (N = 14)
% Female Sample size	n = 3 ; % = 27	n = 6 ; % = 43
Mean age (SD) (years) Mean (SD)	56.6 (9.2)	61.1 (14.8)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (Months) Mean (SD)	66.7 (71.5)	41.3 (45.7)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA

Characteristic	Computer-based tools for speech and language therapy (ORLA treatment) (N = 11)	Speech and language therapy without computer-based tools (usual care) (N = 14)
Aphasia Sample size	n = 11 ; % = 100	n = 14 ; % = 100

Outcomes

Study timepoints

- Baseline
- 3 month (≥3 months)

Continuous outcomes

Outcome	Computer-based tools for speech and language therapy (ORLA treatment), Baseline, N = 11	Computer-based tools for speech and language therapy (ORLA treatment), 3 month, N = 11	Speech and language therapy without computer-based tools (usual care), Baseline, N = 14	Speech and language therapy without computer-based tools (usual care), 3 month, N = 14
Communication - overall language ability (Western Aphasia Battery - AQ) Scale range: 0-100. Change scores. Mean (SD)	62 (19.9)	3.29 (6.16)	47.3 (27.9)	-0.4 (3.44)
Communication - Impairment specific measures, reading (Western Aphasia Battery	68.6 (21.9)	-3.55 (13.16)	59.4 (29.1)	1.36 (12.8)

Outcome	Computer-based tools for speech and language therapy (ORLA treatment), Baseline, N = 11	Computer-based tools for speech and language therapy (ORLA treatment), 3 month, N = 11	Speech and language therapy without computer-based tools (usual care), Baseline, N = 14	Speech and language therapy without computer-based tools (usual care), 3 month, N = 14
reading) Scale range: 0-100. Change scores. Mean (SD)				

Communication - overall language ability (Western Aphasia Battery - AQ) - Polarity - Higher values are better
Communication - Impairment specific measures, reading (Western Aphasia Battery reading) - Polarity - Higher values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-overalllanguageability(WesternAphasiaBattery-AQ)-MeanSD-Computer-based tools for speech and language therapy (ORLA treatment)-Speech and language therapy without computer-based tools (usual care)-t3

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,reading(WesternAphasiaBatteryreading)-MeanSD-Computer-based tools for speech and language therapy (ORLA treatment)-Speech and language therapy without computer-based tools (usual care)-t3

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Cherney, 2021

Bibliographic Reference	Cherney, L. R.; Lee, J. B.; Kim, K. A.; van Vuuren, S.; Web-based Oral Reading for Language in Aphasia (Web ORLA R): A pilot randomized control trial; Clinical Rehabilitation; 2021; vol. 35 (no. 7); 976-987

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	Clinicaltrials.gov = NCT04413136
Study type	Randomised controlled trial (RCT)

Study location	United States of America
Study setting	Free-standing urban rehabilitation hospital.
Study dates	No additional information.
Sources of funding	This study was supported by Grant H133G06055 from the National Institute on Disability, Independent Living, and Rehabilitation Research.
Inclusion criteria	Adults with chronic aphasia (at least six-month post onset) resulting from a single left-hemisphere stroke; native speakers of English; sufficient auditory and visual acuity to interact with a laptop.
Exclusion criteria	Active substance abuse; significant psychological problems; neurological conditions other than stroke; receiving other speech/language treatment for at least one month prior to or during the study.
Recruitment / selection of participants	Recruited February 2008 to July 2010.
Intervention(s)	Computer-based tools for speech and language therapy (Web ORLA) N=22 Web based ORLA (Oral Reading for Language in Aphasia). Practice 90 minutes/day, six days/week for six weeks. People used a 13-inch laptop computer with an audio-headset, which presented auditory stimuli and captured recordings of participants' verbal output. The person was presented with three to five word (level 1) or eight to ten word (level 2) sentences, depending upon the severity of the aphasia. Each sentence was chosen at random by the program from a group of 150 sentences. Allows for interaction with research therapists who are able to provide both synchronous and asynchronous monitoring of practice and real-time adjustments to the program remotely. Concomitant therapy: No additional information.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear

Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	>30 hours
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Reading therapy
Population subgroups	No additional information.
Comparator	Placebo N=13 Commercially available computer game, Bejeweled 2(C). The game does not require verbal production, auditory processing or reading comprehension and so is a "non-language mind game". People were loaned a 13-inch laptop to play this on (as with the intervention group). They were also advised to practice for 90 minutes/day, 6 days a week for 6 weeks. Concomitant therapy: No additional information.
Number of participants	35

Duration of follow-up	6 weeks (post-treatment) and 12 weeks (6 week follow up after post-treatment).
Indirectness	No additional information.
Additional comments	Method of analysis not clear, not ITT

Study arms

Computer-based tools for speech and language therapy (Web ORLA) (N = 22)
Web based ORLA (Oral Reading for Language in Aphasia). Practice 90 minutes/day, six days/week for six weeks. People used a 13-inch laptop computer with an audio-headset, which presented auditory stimuli and captured recordings of participants' verbal output. The person was presented with three to five word (level 1) or eight to ten word (level 2) sentences, depending upon the severity of the aphasia. Each sentence was chosen at random by the program from a group of 150 sentences. Allows for interaction with research therapists who are able to provide both synchronous and asynchronous monitoring of practice and real-time adjustments to the program remotely. Concomitant therapy: No additional information.

Placebo (N = 13)
Commercially available computer game, Bejeweled 2(C). The game does not require verbal production, auditory processing or reading comprehension and so is a "non-language mind game". People were loaned a 13-inch laptop to play this on (as with the intervention group). They were also advised to practice for 90 minutes/day, 6 days a week for 6 weeks. Concomitant therapy: No additional information.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (Web ORLA) (N = 22)	Placebo (N = 13)
% Female Sample size	n = 9 ; % = 47	n = 4 ; % = 31
Mean age (SD) (years) Mean (SD)	58.27 (13.55)	55.19 (11.46)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (Months) Mean (SD)	39.75 (40.76)	60.97 (30.19)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA
Fluent aphasia Sample size	n = 9 ; % = 47	n = 5 ; % = 38

Characteristic	Computer-based tools for speech and language therapy (Web ORLA) (N = 22)	Placebo (N = 13)
Non-fluent aphasia Sample size	n = 10 ; % = 53	n = 8 ; % = 62

The baseline characteristics table reports 19 people in the intervention arm and 13 in the placebo arm

Outcomes

Study timepoints

- Baseline
- 6 week (<3 months)
- 12 week (≥3 months)

Continuous outcome

Outcome	Computer-based tools for speech and language therapy (Web ORLA), Baseline, N = 19	Computer-based tools for speech and language therapy (Web ORLA), 6 week, N = 19	Computer-based tools for speech and language therapy (Web ORLA), 12 week, N = 16	Placebo, Baseline, N = 13	Placebo, 6 week, N = 13	Placebo, 12 week, N = 13
Communication - Overall language ability (Western Aphasia Battery-Revised language quotient) Scale range: 0-100. Mean difference and SD reported (values in the intervention group only).	58.85 (17.98)	0.99 (1.41)	2.7 (1.01)	63.24 (17.34)	NA (NA)	NA (NA)

Outcome	Computer-based tools for speech and language therapy (Web ORLA), Baseline, N = 19	Computer-based tools for speech and language therapy (Web ORLA), 6 week, N = 19	Computer-based tools for speech and language therapy (Web ORLA), 12 week, N = 16	Placebo, Baseline, N = 13	Placebo, 6 week, N = 13	Placebo, 12 week, N = 13
Mean (SD)						

Communication - Overall language ability (Western Aphasia Battery-Revised language quotient) - Polarity - Higher values are better

Dichotomous outcome

Outcome	Computer-based tools for speech and language therapy (Web ORLA), Baseline, N = 19	Computer-based tools for speech and language therapy (Web ORLA), 6 week, N = 19	Computer-based tools for speech and language therapy (Web ORLA), 12 week, N = 19	Placebo, Baseline, N = 13	Placebo, 6 week, N = 13	Placebo, 12 week, N = 13
Discontinuation At 6 weeks: Intervention = 3 dropped out in the first 2 weeks. At 12 weeks: Intervention = 3 dropped out in the first 2 weeks, 1 medial complication, 2 geographically distance. Control: 2 geographically distant. No of events	n = NA ; % = NA	n = 3 ; % = 16	n = 6 ; % = 32	n = NA ; % = NA	n = 0 ; % = 0	n = 2 ; % = 15

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcome-Communication-Overalllanguageability(WesternAphasiaBattery-Revisedlanguagequotient)-MeanSD-Computer-based tools for speech and language therapy (Web ORLA)-Placebo-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcome-Communication-Overalllanguageability(WesternAphasiaBattery-Revisedlanguagequotient)-MeanSD-Computer-based tools for speech and language therapy (Web ORLA)-Placebo-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (Web ORLA)-Placebo-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (Web ORLA)-Placebo-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

De Luca, 2018

Bibliographic Reference	De Luca, R.; Aragona, B.; Leonardi, S.; Torrisi, M.; Galletti, B.; Galletti, F.; Accorinti, M.; Bramanti, P.; De Cola, M. C.; Calabro, R. S.; Computerized Training in Poststroke Aphasia: What About the Long-Term Effects? A Randomized Clinical Trial; Journal of Stroke & Cerebrovascular Diseases; 2018; vol. 27 (no. 8); 2271-2276

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)

Study location	Italy.
Study setting	Outpatient follow up
Study dates	January 2014 to April 2016.
Sources of funding	No additional information.
Inclusion criteria	Diagnosis of first ever ischaemic stroke involving the left hemisphere; a moderate-to-severe level of dependence, as evaluated by the Functional Independence Measure; ability to understand simple tasks; token test (TT) at least 5; presence of words auditory comprehension, being the neuropsychological exam for aphasia (NPEA) at least 10
Exclusion criteria	Disabling sensory alterations (i.e. hearing and visual deficit), severe psychiatric and medical illness.
Recruitment / selection of participants	People who attended the Laboratory of Robotic and Behavioural Rehabilitation of the IRCCS Neurolesi "Bonino Pulejo" of Messina.
Intervention(s)	Computer-based tools for speech and language therapy (Power-Afa) N=17 Power-Afa training 24 sessions of 45 minutes each, 3 times a week for 8 week. Commercially available PC program to optimize language recovery and other cognitive functions. The therapist helps and stimulates during each training session, monitoring the number of errors, the execution time and the task accuracy. The tool present phonological, semantic, written and morphological and syntactic tasks. Concomitant therapy: Traditional training available to all (standard cognitive rehabilitation for language disorders that was founded on cognitive neuropsychological approach to aphasia). 3 training sessions per week for 8 weeks (24 sessions of 45 minutes each). Included stimulation of phonological abilities, the sementic-lexical and morphosyntactic processes delivered face-to-face.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear

Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	11-20 hours
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	In person delivery
Subgroup 6: Method of therapy	Combinations of the above
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=15 Traditional training only. Concomitant therapy: Traditional training available to all (standard cognitive rehabilitation for language disorders that was founded on cognitive neuropsychological approach to aphasia). 3 training sessions per week for 8 weeks (24 sessions of 45 minutes each). Included stimulation of phonological abilities, the sementic-lexical and morphosyntactic processes delivered face-to-face.

Number of participants	32
Duration of follow-up	8 weeks (end of training), 20 weeks (3 months after end of training)
Indirectness	No additional information.
Additional comments	Method of analysis unclear.

Study arms

Computer-based tools for speech and language therapy (Power-Afa) (N = 17)
Power-Afa training 24 sessions of 45 minutes each, 3 times a week for 8 week. Commercially available PC program to optimize language recovery and other cognitive functions. The therapist helps and stimulates during each training session, monitoring the number of errors, the execution time and the task accuracy. The tool present phonological, semantic, written and morphological and syntactic tasks. Concomitant therapy: Traditional training available to all (standard cognitive rehabilitation for language disorders that was founded on cognitive neuropsychological approach to aphasia). 3 training sessions per week for 8 weeks (24 sessions of 45 minutes each). Included stimulation of phonological abilities, the sementic-lexical and morphosyntactic processes delivered face-to-face.

Speech and language therapy without computer-based tools (usual care) (N = 15)
Traditional training only. Concomitant therapy: Traditional training available to all (standard cognitive rehabilitation for language disorders that was founded on cognitive neuropsychological approach to aphasia). 3 training sessions per week for 8 weeks (24 sessions of 45 minutes each). Included stimulation of phonological abilities, the sementic-lexical and morphosyntactic processes delivered face-to-face.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (Power-Afa) (N = 17)	Speech and language therapy without computer-based tools (usual care) (N = 15)
% Female Sample size	n = 7 ; % = 41.2	n = 7 ; % = 46.7
Mean age (SD) (years) Mean (SD)	52.7 (15.2)	50.5 (14.3)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Mean (SD)	NR (NR)	NR (NR)
Time after stroke (Months) Mean (SD)	9.5 (3.2)	10.3 (2.5)
Type of communication difficulty Sample size	n = NR ; % = NR	n = NR ; % = NR

Outcomes

Study timepoints

- Baseline
- 8 week (<3 months)
- 20 week (≥3 months)

Continuous outcomes

Outcome	Computer-based tools for speech and language therapy (Power-Afa), Baseline, N = 17	Computer-based tools for speech and language therapy (Power-Afa), 8 week, N = 17	Computer-based tools for speech and language therapy (Power-Afa), 20 week, N = 17	Speech and language therapy without computer-based tools (usual care), Baseline, N = 15	Speech and language therapy without computer-based tools (usual care), 8 week, N = 15	Speech and language therapy without computer-based tools (usual care), 20 week, N = 15
Psychological distress - depression (Aphasic Depression Rating Scale) Scale range: Unclear. Change scores (Least square mean differences). Mean (SD)	18.1 (6.7)	NA (NR)	NA (NR)	18.3 (5.95)	NA (NR)	NA (NR)
Psychological distress - depression (Aphasic Depression Rating	NA (NA)	5.4 (0.59)	4.8 (0.63)	NA (NA)	0.5 (0.72)	-0.1 (0.77)

Outcome	Computer-based tools for speech and language therapy (Power-Afa), Baseline, N = 17	Computer-based tools for speech and language therapy (Power-Afa), 8 week, N = 17	Computer-based tools for speech and language therapy (Power-Afa), 20 week, N = 17	Speech and language therapy without computer-based tools (usual care), Baseline, N = 15	Speech and language therapy without computer-based tools (usual care), 8 week, N = 15	Speech and language therapy without computer-based tools (usual care), 20 week, N = 15
Scale) Scale range: Unclear. Change scores (Least square mean differences). Mean (SE)						

Psychological distress - depression (Aphasic Depression Rating Scale) - Polarity - Higher values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Psychologicaldistress-depression(AphasicDepressionRatingScale)-MeanSE-Computer-based tools for speech and language therapy (Power-Afa)-Speech and language therapy without computer-based tools (usual care)-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Psychologicaldistress-depression(AphasicDepressionRatingScale)-MeanSE-Computer-based tools for speech and language therapy (Power-Afa)-Speech and language therapy without computer-based tools (usual care)-t20

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Elhakeem, 2021

Bibliographic Reference	Elhakeem, E. S.; Saeed, S. S.; Elsalakawy, R. N.; Elmaghraby, R. M.; Ashmawy, G. A.; Post-stroke aphasia rehabilitation using computer-based Arabic software program: a randomized controlled trial; Egyptian journal of otolaryngology; 2021; vol. 37 (no. 1); 77

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)

Study location	Egypt
Study setting	Outpatient follow up (in the Phoniatrics unit).
Study dates	January 2018 to September 2019
Sources of funding	This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.
Inclusion criteria	Post-stroke aphasic patients who were 18 years old or more; arabic speaking; people with aphasia in any phase (acute, subacute or chronic).
Exclusion criteria	Intellectual disabilities; visual impairment; hearing impairment; associated dysarthria; apraxia of speech and associated psychiatric disorders.
Recruitment / selection of participants	People who attended the Phoniatrics unit.
Intervention(s)	Computer-based tools for speech and language therapy (Arabic software program) N=25 The software Rawag. Software including sections such as: auditory comprehension training materials, word-finding training materials, sentence structure exercises, oral expression training materials, writing, spelling, reading, arithmetic, time and preservation treatment. The program provides visual and/or auditory feedback after getting the answers. The core concept of the program depends on the principles of Schuell's Stimulation Approach which depends on intensive auditory stimulation to facilitate language recovery. This approach involves several principles as using repetitive sensory stimulation to elicit the maximum number of responses, intensive and systemic work with feedback. This was delivered in therapy sessions with 2 sessions per week for 60 minutes a session with a total of 48 sessions over 6 months. Concomitant therapy: No additional information.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear

Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	>30 hours
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months) Majority Chronic (around 90%)
Subgroup 5: Remote delivery compared to in person delivery of sessions	In person delivery
Subgroup 6: Method of therapy	Combinations of the above
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=25 Conventional therapy provided for 2 sessions per week for 60 minutes with a total of 48 sessions over 6 months. Concomitant therapy: No additional information.
Number of participants	50
Duration of follow-up	6 months

Indirectness	No additional information.
Additional comments	ITT no dropouts

Study arms

Computer-based tools for speech and language therapy (Arabic software program) (N = 25)
The software Rawag. Software including sections such as: auditory comprehension training materials, word-finding training materials, sentence structure exercises, oral expression training materials, writing, spelling, reading, arithmetic, time and preservation treatment. The program provides visual and/or auditory feedback after getting the answers. The core concept of the program depends on the principles of Schuell's Stimulation Approach which depends on intensive auditory stimulation to facilitate language recovery. This approach involves several principles as using repetitive sensory stimulation to elicit the maximum number of responses, intensive and systemic work with feedback. This was delivered in therapy sessions with 2 sessions per week for 60 minutes a session with a total of 48 sessions over 6 months. Concomitant therapy: No additional information.

Speech and language therapy without computer-based tools (usual care) (N = 25)
Conventional therapy provided for 2 sessions per week for 60 minutes with a total of 48 sessions over 6 months. Concomitant therapy: No additional information.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (Arabic software program) (N = 25)	Speech and language therapy without computer-based tools (usual care) (N = 25)
% Female Sample size	n = 5 ; % = 20	n = 5 ; % = 20

Characteristic	Computer-based tools for speech and language therapy (Arabic software program) (N = 25)	Speech and language therapy without computer-based tools (usual care) (N = 25)
Mean age (SD) (years) Mean (SD)	57.04 (10.88)	58.8 (11.58)
Ethnicity Sample size	n = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke Sample size	n = NA ; % = NA	n = NA ; % = NA
Acute Sample size	n = 2 ; % = 8	n = 2 ; % = 8
Subacute Sample size	n = 0 ; % = 0	n = 1 ; % = 4
Chronic Sample size	n = 23 ; % = 92	n = 22 ; % = 88
Type of communication difficulty	n = NA ; % = NA	n = NA ; % = NA

Characteristic	Computer-based tools for speech and language therapy (Arabic software program) (N = 25)	Speech and language therapy without computer-based tools (usual care) (N = 25)
Sample size		
Global aphasia Sample size	n = 8 ; % = 32	n = 8 ; % = 32
Broca's aphasia Sample size	n = 7 ; % = 28	n = 5 ; % = 20
Transcortical motor aphasia Sample size	n = 4 ; % = 16	n = 5 ; % = 20
Transcortical mixed aphasia Sample size	n = 5 ; % = 20	n = 7 ; % = 28
Anomic aphasia Sample size	n = 1 ; % = 4	n = 0 ; % = 0

Outcomes

Study timepoints
- Baseline
- 6 month (≥3 months)

1 ***Continuous outcomes***

Outcome	Computer-based tools for speech and language therapy (Arabic software program), Baseline, N = 25	Computer-based tools for speech and language therapy (Arabic software program), 6 month, N = 25	Speech and language therapy without computer-based tools (usual care), Baseline, N = 25	Speech and language therapy without computer-based tools (usual care), 6 month, N = 25
Communication - overall language ability (Aphasia severity rating scale) Scale range: 0-5. Change scores. Mean (SD)	0.8 (0.58)	2.48 (0.77)	0.92 (0.76)	2.44 (0.92)
Communication - impairment specific measures, auditory comprehension (BDAE auditory comprehension) Change scores. Mean (SD)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
BDAE Basic word discrimination Change scores. Scale range: 0-72. Mean (SD)	21.4 (13.14)	10.56 (9.22)	19.52 (12.94)	10.36 (8.53)
BDAE Commands Change scores. Scale range: 0-24. Mean (SD)	7.08 (5.73)	4.88 (3.68)	6.64 (5.69)	4.8 (3.81)
BDAE Complex ideational material Change scores. Scale range: 0-10.	4.52 (3.96)	4.6 (2.27)	3.96 (4.41)	4.4 (2.97)

Outcome	Computer-based tools for speech and language therapy (Arabic software program), Baseline, N = 25	Computer-based tools for speech and language therapy (Arabic software program), 6 month, N = 25	Speech and language therapy without computer-based tools (usual care), Baseline, N = 25	Speech and language therapy without computer-based tools (usual care), 6 month, N = 25
Mean (SD)				
Communication - Impairment specific measures, naming (Boston Naming Test) (items) Change scores. Mean (SD)	7.92 (9.22)	47.04 (11.06)	6.92 (6.38)	37.08 (11.33)
Communication - Impairment specific measures, reading (BDAE Oral Reading) Change scores. Mean (SD)	NA (NA)	NA (NA)	NA (NA)	NA (NA)
BDAE Basic oral reading Scale range: 0-30. Mean (SD)	6.15 (8.45)	10.3 (5.32)	3.95 (5.53)	10.21 (6.24)
BDAE oral reading of sentences with comprehension Scale range: 0-10 Mean (SD)	4.85 (2.87)	4.6 (1.73)	3.21 (2.76)	4.53 (2.04)
Communication - Impairment specific measures, Expressive language (BDAE conversational	NA (NA)	NA (NA)	NA (NA)	NA (NA)

Outcome	Computer-based tools for speech and language therapy (Arabic software program), Baseline, N = 25	Computer-based tools for speech and language therapy (Arabic software program), 6 month, N = 25	Speech and language therapy without computer-based tools (usual care), Baseline, N = 25	Speech and language therapy without computer-based tools (usual care), 6 month, N = 25
and expository speech) Scale range: 1-7. Change scores. Mean (SD)				
BDAE articulatory agility Scale range: 1-7. Change scores. Mean (SD)	5.28 (1.17)	1.24 (0.78)	5.48 (1.69)	1.04 (1.14)
BDAE phrase length Scale range: 1-7. Change scores. Mean (SD)	1.44 (0.82)	2.8 (1.22)	1.84 (1.11)	2.12 (0.73)
BDAE Grammatical forms Scale range: 1-7. Change scores. Mean (SD)	1.16 (0.62)	2.88 (1.17)	1.28 (0.54)	2.4 (1.04)
BDAE Melodic line Scale range: 1-7. Change scores. Mean (SD)	2.52 (0.82)	3.04 (1.06)	2.4 (1.08)	2.04 (1.06)
BDAE Word-finding relative to fluency Scale range: 1-7. Change scores. Mean (SD)	4.36 (0.95)	1.28 (1.1)	5.12 (1.33)	0.48 (1.73)

Outcome	Computer-based tools for speech and language therapy (Arabic software program), Baseline, N = 25	Computer-based tools for speech and language therapy (Arabic software program), 6 month, N = 25	Speech and language therapy without computer-based tools (usual care), Baseline, N = 25	Speech and language therapy without computer-based tools (usual care), 6 month, N = 25
BDAE Paraphrasia Scale range: 1-7. Change scores. Mean (SD)	2.08 (2)	3.92 (2.25)	2.72 (2.34)	2.28 (2.01)

Communication - overall language ability (Aphasia severity rating scale) - Polarity - Higher values are better
Communication - impairment specific measures, auditory comprehension (BDAE auditory comprehension) - Polarity - Higher values are better
Communication - Impairment specific measures, naming (Boston Naming Test) - Polarity - Higher values are better
Communication - Impairment specific measures, reading (BDAE Oral Reading) - Polarity - Higher values are better
Communication - Impairment specific measures, Expressive language (BDAE conversational and expository speech) - Polarity - Higher values are better

Dichotomous outcome

Outcome	Computer-based tools for speech and language therapy (Arabic software program), Baseline, N = 25	Computer-based tools for speech and language therapy (Arabic software program), 6 month, N = 25	Speech and language therapy without computer-based tools (usual care), Baseline, N = 25	Speech and language therapy without computer-based tools (usual care), 6 month, N = 25
Discontinuation No of events	n = NA ; % = NA	n = 0 ; % = 0	n = NA ; % = NA	n = 0 ; % = 0

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-overalllanguageability(Aphasiaseverityratingscale)-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,auditorycomprehension(BDAEauditorycomprehension)-BDAEBasicworddiscrimination-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,auditorycomprehension(BDAEauditorycomprehension)-BDAECommands-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,auditorycomprehension(BDAEauditorycomprehension)-BDAEComplexideationalmaterial-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,naming(BostonNamingTest)-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,reading(BDAEOralReading)-BDAEBasicoralreading-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,reading(BDAEOralReading)-BDAEoralreadingofsentenceswithcomprehension-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,Expressivelanguage(BDAEconversationalandexpositoryspeech)-BDAEarticulatoryagility-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,Expressivelanguage(BDAEconversationalandexpositoryspeech)-BDAEphraselength-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,Expressivelanguage(BDAEconversationalandexpositoryspeech)-BDAEGrammaticalforms-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,Expressivelanguage(BDAEconversationalandexpositoryspeech)-BDAEMelodicline-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,Expressivelanguage(BDAEconversationalandexpositoryspeech)-BDAEWord-findingrelativetofluency-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,Expressivelanguage(BDAEconversationalandexpositoryspeech)-BDAEParaphrasia-MeanSD-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (Arabic software program)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Katz, 1991

Bibliographic Reference	Katz, R. C.; Wertz, R. T.; Lewis, S. M.; Esparza, C.; Goldojarb, M.; A comparison of computerized reading treatment, computer stimulation, and no treatment for aphasia; Clinical aphasiology: volume 19; 1991; 243-254

Study details

Secondary publication of another included	No additional information.

study- see primary study for details	
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)
Study location	United States of America.
Study setting	Outpatient follow up.
Study dates	No additional information.
Sources of funding	This project was supported in part by the U.S. Department of Veterans Affairs Rehabilitation Research and Development, Department of Medicine and Surgery.
Inclusion criteria	Aphasic adults who had a single, occlusive, left-hemisphere cerebrovascular accident resulting in aphasia of at least 1 years duration; premorbidly right-handed; literature in English; had completed at least the eighth grade.
Exclusion criteria	Premorbid psychiatric, reading or writing problems; did not receive any other speech and language therapy.
Recruitment / selection of participants	No additional information.
Intervention(s)	Computer-based tools for speech and language therapy (computer reading treatment) N=10 Computer reading treatment. The computer reading treatment group used computers 3 hours each week to run visual-matching and reading comprehension software. Treatment was for 13 weeks (39 hours in total). Concomitant therapy: No additional information.

Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	>30 hours
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	In person delivery
Subgroup 6: Method of therapy	Word finding therapy
Population subgroups	No additional information.
Comparator	Placebo (computer stimulation) N=7 Computer stimulation. 3 hours computer use per week using cognitive rehabilitation software and computerized arcade-type games that did not include language stimuli.

	Concomitant therapy: No additional information. No treatment N=5 The no treatment group received no computer reading treatment or stimulation, but they were evaluated at the beginning and end of the 13-week treatment trial. Concomitant therapy: No additional information.
Number of participants	23
Duration of follow-up	13 weeks (end of intervention)
Indirectness	No additional information.
Additional comments	Method of analysis unclear.

Study arms

Computer-based tools for speech and language therapy (computer reading treatment) (N = 10)

Computer reading treatment. The computer reading treatment group used computers 3 hours each week to run visual-matching and reading comprehension software. Treatment was for 13 weeks (39 hours in total). Concomitant therapy: No additional information.

Placebo (computer stimulation) (N = 7)

Computer stimulation. 3 hours computer use per week using cognitive rehabilitation software and computerized arcade-type games that did not include language stimuli. Concomitant therapy: No additional information.

No treatment (N = 5)

The no treatment group received no computer reading treatment or stimulation, but they were evaluated at the beginning and end of the 13-week treatment trial. Concomitant therapy: No additional information.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (computer reading treatment) (N = 10)	Placebo (computer stimulation) (N = 7)	No treatment (N = 5)
% Female Sample size	n = 1 ; % = 10	n = 0 ; % = 0	n = 0 ; % = 0
Mean age (SD) (years) Mean (SD)	61.1 (6.7)	66.86 (5.3)	60.4 (5)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR	n = NR ; % = NR

Characteristic	Computer-based tools for speech and language therapy (computer reading treatment) (N = 10)	Placebo (computer stimulation) (N = 7)	No treatment (N = 5)
Time after stroke (years) Mean (SD)	5.45 (4.5)	3.43 (1.4)	5.35 (3)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA	n = NA ; % = NA

Outcomes

Study timepoints

- Baseline
- 13 week (≥3 months)

Continuous outcomes

Outcome	Computer-based tools for speech and language therapy (computer reading treatment), Baseline, N = 10	Computer-based tools for speech and language therapy (computer reading treatment), 13 week, N = 10	Placebo (computer stimulation), Baseline, N = 7	Placebo (computer stimulation), 13 week, N = 7	No treatment, Baseline, N = 5	No treatment, 13 week, N = 5
Communication - overall language ability (Western Aphasia Battery AQ)	73.7 (14.7)	1.6 (3.2)	63.4 (24.9)	1 (1)	72.6 (14.2)	-1.4 (2.3)

Outcome	Computer-based tools for speech and language therapy (computer reading treatment), Baseline, N = 10	Computer-based tools for speech and language therapy (computer reading treatment), 13 week, N = 10	Placebo (computer stimulation), Baseline, N = 7	Placebo (computer stimulation), 13 week, N = 7	No treatment, Baseline, N = 5	No treatment, 13 week, N = 5
Scale range: 0-100. Change scores. Mean (SD)						

Communication - overall language ability (Western Aphasia Battery AQ) - Polarity - Higher values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-overalllanguageability(WesternAphasiaBatteryAQ)-MeanSD-Computer-based tools for speech and language therapy (computer reading treatment)-Placebo (computer stimulation)-No treatment-t13

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Kesav, 2017

Bibliographic Reference	Kesav, P.; Vrinda, S. L.; Sukumaran, S.; Sarma, P. S.; Sylaja, P. N.; Effectiveness of speech language therapy either alone or with add-on computer-based language therapy software (Malayalam version) for early post stroke aphasia: A feasibility study; Journal of the Neurological Sciences; 2017; vol. 380; 137-141

1

2 **Study details**

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	Clinical trials registry India (2016/08/0120121).
Study type	Randomised controlled trial (RCT)
Study location	India.
Study setting	Tertiary health care institution outpatient follow up.
Study dates	September 2013 and January 2016
Sources of funding	Centre for Disability Studies, Government of India (CeDS/FA/2011-2012).
Inclusion criteria	Right handed subjects; aged 15 years or above; should present for evaluation within three months of suffering the first ever episode of ischaemic stroke in the middle cerebral artery (defined on CT scan or MRI scan); with either anomic, Broca's, Wernicke's, Transcortical motor/sensory aphasia or conduction aphasia; Western Aphasia Battery score of <93.8 on initial assessment.
Exclusion criteria	Brainstem stroke; bilateral stroke; haemorrhagic stroke; cognitive impairment (MMSE score below 24); unstable cardiopulmonary status/other diseases likely to hamper the four weeks follow up and those who could not speak/read/write Malayalam premorbidly.

Recruitment / selection of participants	No additional information.
Intervention(s)	Computer-based tools for speech and language therapy (MOZHI) N=12 12 hours of addition supervised computer based language rehabilitation therapy for 1 hour per session being delivered three times a week for 4 weeks. This was based on hexarchial language hierarchy modules for improving auditory verbal comprehension; expression of language assessment; naming; writing; reading and calculation. Concomitant therapy: Speech and language therapist mediated conventional therapy for 12 hours with 1 hour sessions being delivered three times a week for 4 weeks.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	11-20 hours
Subgroup 4: Time after stroke at the start of the trial	Subacute (7 days - 6 months)
Subgroup 5: Remote delivery compared to in	In person delivery

person delivery of sessions	
Subgroup 6: Method of therapy	Combinations of the above
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=12 Conventional therapy only themed on the same premises only. Concomitant therapy: Speech and language therapist mediated conventional therapy for 12 hours with 1 hour sessions being delivered three times a week for 4 weeks.
Number of participants	24
Duration of follow-up	4 weeks (end of intervention)
Indirectness	No additional information
Additional comments	No information on method of analysis (appears to only include completers)

Study arms

Computer-based tools for speech and language therapy (MOZHI) (N = 12)

12 hours of addition supervised computer based language rehabilitation therapy for 1 hour per session being delivered three times a week for 4 weeks. This was based on hexarchial language hierarchy modules for improving auditory verbal comprehension; expression of language assessment; naming; writing; reading and calculation. Concomitant therapy: Speech and language therapist mediated conventional therapy for 12 hours with 1 hour sessions being delivered three times a week for 4 weeks.

Speech and language therapy without computer-based tools (usual care) (N = 12)

Conventional therapy only themed on the same premises only. Concomitant therapy: Speech and language therapist mediated conventional therapy for 12 hours with 1 hour sessions being delivered three times a week for 4 weeks.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (MOZHI) (N = 12)	Speech and language therapy without computer-based tools (usual care) (N = 12)
% Female Sample size	n = 4 ; % = 36	n = 2 ; % = 22
Mean age (SD) (years) Mean (SD)	56.27 (11.62)	48.67 (11.83)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (days) Mean (SD)	31.2 (31)	29.3 (30)

Characteristic	Computer-based tools for speech and language therapy (MOZHI) (N = 12)	Speech and language therapy without computer-based tools (usual care) (N = 12)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA

Baseline characteristics reported for final cohort, therefore assuming 11 people received computer-based tools and 9 received conventional therapy only.

Outcomes

Study timepoints
- Baseline
- 4 week (<3 months)
- 12 week (≥3 months)

Continuous outcome

Outcome	Computer-based tools for speech and language therapy (MOZHI), Baseline, N = 11	Computer-based tools for speech and language therapy (MOZHI), 4 week, N = 11	Computer-based tools for speech and language therapy (MOZHI), 12 week, N = 11	Speech and language therapy without computer-based tools (usual care), Baseline, N = 9	Speech and language therapy without computer-based tools (usual care), 4 week, N = 9	Speech and language therapy without computer-based tools (usual care), 12 week, N = 9
Communication - overall language ability (Western Aphasia Battery Aphasia Quotient)	45.1 (28.4)	63.5 (33.8)	67.6 (32.7)	32.4 (25.8)	65.1 (27.6)	73.3 (32.7)

Outcome	Computer-based tools for speech and language therapy (MOZHI), Baseline, N = 11	Computer-based tools for speech and language therapy (MOZHI), 4 week, N = 11	Computer-based tools for speech and language therapy (MOZHI), 12 week, N = 11	Speech and language therapy without computer-based tools (usual care), Baseline, N = 9	Speech and language therapy without computer-based tools (usual care), 4 week, N = 9	Speech and language therapy without computer-based tools (usual care), 12 week, N = 9
Scale range: 0-100. Final values. Mean (SD)						

1 Communication - overall language ability (Western Aphasia Battery Aphasia Quotient) - Polarity - Higher values are better

2 ***Dichotomous outcome***

Outcome	Computer-based tools for speech and language therapy (MOZHI), Baseline, N = 12	Computer-based tools for speech and language therapy (MOZHI), 4 week, N = 12	Computer-based tools for speech and language therapy (MOZHI), 12 week, N = 12	Speech and language therapy without computer-based tools (usual care), Baseline, N = 12	Speech and language therapy without computer-based tools (usual care), 4 week, N = 12	Speech and language therapy without computer-based tools (usual care), 12 week, N = 12
Discontinuation Intervention: 1 withdrew consent. Control: 2 lost to follow-up (expired), 1 withdrew consent. No of events	n = NA ; % = NA	n = 1 ; % = 8	n = 1 ; % = 8	n = NA ; % = NA	n = 3 ; % = 25	n = 3 ; % = 25

3 Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcome-Communication-overalllanguageability(WesternAphasiaBatteryAphasiaQuotient)-MeanSD-Computer-based tools for speech and language therapy (MOZHI)-Speech and language therapy without computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcome-Communication-overalllanguageability(WesternAphasiaBatteryAphasiaQuotient)-MeanSD-Computer-based tools for speech and language therapy (MOZHI)-Speech and language therapy without computer-based tools (usual care)-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (MOZHI)-Speech and language therapy without computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (MOZHI)-Speech and language therapy without computer-based tools (usual care)-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Latimer, 2021

Bibliographic Reference	Latimer, N. R.; Bhadhuri, A.; Alshreef, A.; Palmer, R.; Cross, E.; Dimairo, M.; Julious, S.; Cooper, C.; Enderby, P.; Brady, M. C.; Bowen, A.; Bradley, E.; Harrison, M.; Self-managed, computerised word finding therapy as an add-on to usual care for chronic aphasia post-stroke: An economic evaluation; Clinical Rehabilitation; 2021; vol. 35 (no. 5); 703-717

Study details

Secondary publication of another included study- see primary study for details	Palmer, R., Dimairo, M., Cooper, C. et al. (2019) 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. Lancet Neurology 18(9): 821-833

Latimer, 2013

Bibliographic Reference	Latimer, N. R.; Dixon, S.; Palmer, R.; Cost-utility of self-managed computer therapy for people with aphasia; International Journal of Technology Assessment in Health Care; 2013; vol. 29 (no. 4); 402-9

Study details

Secondary publication of another included study- see primary study for details	Palmer, R., Enderby, P., Cooper, C. et al. (2012) Computer therapy compared with usual care for people with long-standing aphasia poststroke: a pilot randomized controlled trial. Stroke 43(7): 1904-11

Liu, 2021

Bibliographic Reference	Liu, M.; Qian, Q.; Wang, W.; Chen, L.; Wang, L.; Zhou, Y.; Xu, S.; Wu, J.; Feng, T.; Zhu, Z.; Xiang, J.; Improvement in language function in patients with aphasia using computer-assisted executive function training: A controlled clinical trial; Pm & R; 2021; vol. 26; 26

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.

Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)
Study location	China.
Study setting	Outpatient follow up (department of rehabilitation, affiliated hospital of Xuzhou Medical University)
Study dates	No additional information.
Sources of funding	This study was funded by the National Science Foundation of China (31871133), National Key Research and Development Programs (2020YFC2006604), and Xuzhou Science and Technology Project (KC17177).
Inclusion criteria	Aphasic survivors (confirmed using the Western Aphasia Battery) with executive dysfunction (as assessed by the Verbal Fluency Test, the Proverbs Test, the Tower of London Test, the Stroop Colour and Word Test, and the Trail Making Test) after ischaemic or haemorrhagic stroke; normal vital signs 48 hours post-onset; first onset (confirmed by computer tomography or magnetic resonance imaging); were 18-80 years old; were native Chinese peakers.
Exclusion criteria	Any aphasic deficits before onset; severe cognitive disorders that meant they could not comply with therapists; a psychiatric history or any other progressive disorder that might interfere with aphasia assessment; unable to operate with computer-assisted executive control training; unable to follow study protocol.
Recruitment / selection of participants	No additional information.
Intervention(s)	Computer-based tools for speech and language therapy (computer-assisted executive control training) N=35 30 minutes of speech and language therapy combined with computer-assisted executive control training for 30 minutes once a day, 6 days a week for up to 4 weeks. Adopted from Wispirit Ltd. using a computerized, multidomain, adaptive training module. The training paradigm consisted of five areas: memory training, computational reasoning, attention, flexibility and emotional management. Specific training modules encompass the SCWT, switching task, attention span task and paired-associate recall task.

	Concomitant therapy: Speech and language therapy was focused on training-specific deficits with corresponding training modules that covered auditory comprehension, repetition, reading, naming and writing.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	11-20 hours
Subgroup 4: Time after stroke at the start of the trial	Subacute (7 days - 6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	In person delivery
Subgroup 6: Method of therapy	Other Cognitive therapy
Population subgroups	No additional information.
Comparator	Speech and language therapy with computer-based tools (usual care) N=35

	Speech and language therapy for 4 weeks. Routine language training for 30 minutes two times a day, 6 days a week for a total of 4 weeks. Concomitant therapy: Speech and language therapy was focused on training-specific deficits with corresponding training modules that covered auditory comprehension, repetition, reading, naming and writing.
Number of participants	70
Duration of follow-up	4 weeks (end of intervention)
Indirectness	No additional information.
Additional comments	No information on method of analysis, appears to be completers only.

Study arms

Computer-based tools for speech and language therapy (computer-assisted executive control training) (N = 35)
30 minutes of speech and language therapy combined with computer-assisted executive control training for 30 minutes once a day, 6 days a week for up to 4 weeks. Adopted from Wispirit Ltd. using a computerized, multidomain, adaptive training module. The training paradigm consisted of five areas: memory training, computational reasoning, attention, flexibility and emotional management. Specific training modules encompass the SCWT, switching task, attention span task and paired-associate recall task. Concomitant therapy: Speech and language therapy was focused on training-specific deficits with corresponding training modules that covered auditory comprehension, repetition, reading, naming and writing.

Speech and language therapy without computer-based tools (usual care) (N = 35)
Speech and language therapy for 4 weeks. Routine language training for 30 minutes two times a day, 6 days a week for a total of 4 weeks. Concomitant therapy: Speech and language therapy was focused on training-specific deficits with corresponding training modules that covered auditory comprehension, repetition, reading, naming and writing.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (computer-assisted executive control training) (N = 35)	Speech and language therapy without computer-based tools (usual care) (N = 35)
% Female Sample size	n = 10 ; % = 29	n = 9 ; % = 26
Mean age (SD) (years) Mean (SD)	51.5 (15.1)	54.3 (12.8)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (days) Range	15 to 73	18 to 90
Time after stroke (days) Mean (SD)	28.3 (NR)	30.2 (NR)

Characteristic	Computer-based tools for speech and language therapy (computer-assisted executive control training) (N = 35)	Speech and language therapy without computer-based tools (usual care) (N = 35)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA
Anomic aphasia Sample size	n = 4 ; % = 12	n = 6 ; % = 17
Brocha's aphasia Sample size	n = 12 ; % = 36	n = 10 ; % = 29
Wernicke's aphasia Sample size	n = 5 ; % = 15	n = 7 ; % = 20
Global aphasia Sample size	n = 8 ; % = 24	n = 10 ; % = 29
Not classified Sample size	n = 4 ; % = 12	n = 2 ; % = 6

Number of participants in the intervention arm is reported as 33.

Outcomes

Study timepoints

- Baseline
- 4 week (<3 months)

Continuous outcomes

Outcome	Computer-based tools for speech and language therapy (computer-assisted executive control training), Baseline, N = 33	Computer-based tools for speech and language therapy (computer-assisted executive control training), 4 week, N = 33	Speech and language therapy without computer-based tools (usual care), Baseline, N = 35	Speech and language therapy without computer-based tools (usual care), 4 week, N = 35
Communication - overall language ability (Western Aphasia Battery Aphasia Quotient) Scale range: 0-100. Change scores. Mean (SD)	35.27 (21.7)	18.08 (8.43)	34.75 (22.92)	5.2 (9.79)
Communication - Impairment specific measures, naming (Western Aphasia Battery oral naming) Scale range: Unclear. Change scores. Mean (SD)	2.35 (1.7)	1.26 (2.92)	2.08 (1.79)	0.37 (2.44)
Communication - Impairment specific measures, auditory comprehension (Western Aphasia Battery auditory comprehension) Scale range: Unclear. Change scores.	4.41 (2.47)	2.31 (1.26)	4.31 (2.89)	2.44 (0.93)

Outcome	Computer-based tools for speech and language therapy (computer-assisted executive control training), Baseline, N = 33	Computer-based tools for speech and language therapy (computer-assisted executive control training), 4 week, N = 33	Speech and language therapy without computer-based tools (usual care), Baseline, N = 35	Speech and language therapy without computer-based tools (usual care), 4 week, N = 35
Mean (SD)				
Communication - Impairment specific measures, Expressive language (Western Aphasia Battery Spontaneous speech) Scale range: Unclear. Change scores. Mean (SD)	6.51 (4.94)	3.13 (3.04)	6.57 (4.84)	1.4 (2.1)

Communication - overall language ability (Western Aphasia Battery Aphasia Quotient) - Polarity - Higher values are better
Communication - Impairment specific measures, naming (Western Aphasia Battery oral naming) - Polarity - Higher values are better
Communication - Impairment specific measures, auditory comprehension (Western Aphasia Battery auditory comprehension) - Polarity - Higher values are better
Communication - Impairment specific measures, Expressive language (Western Aphasia Battery Spontaneous speech) - Polarity - Higher values are better

Dichotomous outcome

Outcome	Computer-based tools for speech and language therapy (computer-assisted executive control training), Baseline, N = 35	Computer-based tools for speech and language therapy (computer-assisted executive control training), 4 week, N = 35	Speech and language therapy without computer-based tools (usual care), Baseline, N = 35	Speech and language therapy without computer-based tools (usual care), 4 week, N = 35
Discontinuation Intervention: 1 unable to	n = NA ; % = NA	n = 2 ; % = 6	n = NA ; % = NA	n = 0 ; % = 0

Outcome	Computer-based tools for speech and language therapy (computer-assisted executive control training), Baseline, N = 35	Computer-based tools for speech and language therapy (computer-assisted executive control training), 4 week, N = 35	Speech and language therapy without computer-based tools (usual care), Baseline, N = 35	Speech and language therapy without computer-based tools (usual care), 4 week, N = 35
finish assessment, 1 unable to follow up. No of events				

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-overalllanguageability(WesternAphasiaBatteryAphasiaQuotient)-MeanSD-Computer-based tools for speech and language therapy (computer-assisted executive control training)-Speech and language therapy with computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,naming(WesternAphasiaBatteryoralnaming)-MeanSD-Computer-based tools for speech and language therapy (computer-assisted executive control training)-Speech and language therapy with computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,auditorycomprehension(WesternAphasiaBatteryauditorycomprehension)-MeanSD-Computer-based tools for speech and language therapy (computer-assisted executive control training)-Speech and language therapy with computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,Expressivelanguage(WesternAphasiaBatterySpontaneousspeech)-MeanSD-Computer-based tools for speech and language therapy (computer-assisted executive control training)-Speech and language therapy with computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (computer-assisted executive control training)-Speech and language therapy with computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Maresca, 2019

Bibliographic Reference	Maresca, G.; Maggio, M. G.; Latella, D.; Cannavo, A.; De Cola, M. C.; Portaro, S.; Stagnitti, M. C.; Silvestri, G.; Torrisi, M.; Bramanti, A.; De Luca, R.; Calabro, R. S.; Toward Improving Poststroke Aphasia: A Pilot Study on the Growing Use of Telerehabilitation for the Continuity of Care; Journal of Stroke & Cerebrovascular Diseases; 2019; vol. 28 (no. 10); 104303

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)

Study location	Italy.
Study setting	Initially inpatients.
Study dates	No additional information.
Sources of funding	No additional information.
Inclusion criteria	Diagnosis of vascular brain injury of either haemorrhagic or ischaemic etiology (the latter involving the middle cerebral artery); absence of severe spasticity with an Ashworth Scale less than 3; absence of disabling sensory alterations (i.e. hearing and visual loss); absence of severe medical and psychiatric illness, according to the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition and International Classification of Diseases-10.
Exclusion criteria	Severe paresis of the upper limb (muscle research council <3); severe cognitive impairment; epileptic seizures nonresponding to treatment.
Recruitment / selection of participants	All people were inpatients admitted to the IRCCS Centro Neurolesi "Bonino-Pulejo" of Messina.
Intervention(s)	Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet) N=15 Two phases. In phase one: experimental linguistic therapy performed using a virtual reality rehabilitation system. Each exercise of the therapy had a self-advancement of difficulty, to guarantee the best-personalised training. In phase 2, they were provided with a touchscreen tablet (virtual reality rehabilitation system-tablet) both the groups were submitted to the same amount of treatment. The tablet contained the previous linguistic exercises modulated on the capability of each patient. Twice a week the neuropsychologist performed a videoconference to monitor the rehabilitation process carried out in their own home and discuss the feasibility and performance of the exercises. The tablet allowed for provision of exercises and monitoring of the person remotely in their home. The tablet contains about 30 different exercises with over 1000 customisable and editable levels, divided into cognitive and linguistic modules, which includes exercises on attention, memory, perception, executive functions and speech/language abilities. The exercises automatically adapt to the person's performance. There were two main categories of exercises, the first being 2D exercises in which the person interacts with objects and scenarios through the touch screen or particular magnetic sensor coupled with a button, which emulates mouse interaction. The second one consists of 3D exercises, in which people interact with 3D virtual scenarios and immersive objects through a magnetic localisation sensor generally positioned on the hand. The study lasted 6 months and included the two phases which lasted 12 weeks each. Training was completed 5 days a week with each session lasting about 50 minutes.

	Concomitant therapy: No additional information.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	>30 hours
Subgroup 4: Time after stroke at the start of the trial	Not stated/unclear
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Combinations of the above
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=15

	Traditional linguistic treatment with the same exercises as the experimental linguistic therapy. The study lasted 6 months and included the two phases which lasted 12 weeks each. Training was completed 5 days a week with each session lasting about 50 minutes. Concomitant therapy: No additional information.
Number of participants	30
Duration of follow-up	6 months.
Indirectness	No additional information.
Additional comments	No additional information.

Study arms

Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet) (N = 15)

Two phases. In phase one: experimental linguistic therapy performed using a virtual reality rehabilitation system. Each exercise of the therapy had a self-advancement of difficulty, to guarantee the best-personalised training. In phase 2, they were provided with a touchscreen tablet (virtual reality rehabilitation system-tablet) both the groups were submitted to the same amount of treatment. The tablet contained the previous linguistic exercises modulated on the capability of each patient. Twice a week the neuropsychologist performed a videoconference to monitor the rehabilitation process carried out in their own home and discuss the feasibility and performance of the exercises. The tablet allowed for provision of exercises and monitoring of the person remotely in their home. The tablet contains about 30 different exercises with over 1000 customisable and editable levels, divided into cognitive and linguistic modules, which includes exercises on attention, memory, perception, executive functions and speech/language abilities. The exercises automatically adapt to the person's performance. There were two main categories of exercises, the first being 2D exercises in which the person interacts with objects and scenarios through the touch screen or particular magnetic sensor coupled with a button, which emulates mouse interaction. The second one consists of 3D exercises, in which people interact with 3D virtual scenarios and immersive objects through a magnetic localisation sensor generally positioned on the hand. The study lasted 6 months and included the two phases which lasted 12 weeks each. Training was completed 5 days a week with each session lasting about 50 minutes. Concomitant therapy: No additional information.

Speech and language therapy without computer-based tools (usual care) (N = 15)

Traditional linguistic treatment with the same exercises as the experimental linguistic therapy. The study lasted 6 months and included the two phases which lasted 12 weeks each. Training was completed 5 days a week with each session lasting about 50 minutes. Concomitant therapy: No additional information.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet) (N = 15)	Speech and language therapy without computer-based tools (usual care) (N = 15)
% Female Sample size	n = 8 ; % = 53.3	n = 8 ; % = 53.3
Mean age (SD) (years) Mean (SD)	51.1 (10.3)	51.4 (12.7)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity	n = NR ; % = NR	n = NR ; % = NR

Characteristic	Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet) (N = 15)	Speech and language therapy without computer-based tools (usual care) (N = 15)
Sample size		
Time after stroke Sample size	n = NR ; % = NR	n = NR ; % = NR
Type of communication difficulty Sample size	n = NR ; % = NR	n = NR ; % = NR

Outcomes

Study timepoints

- Baseline
- 6 month (≥3 months)

Continuous outcomes

Outcome	Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet), Baseline, N = 15	Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet), 6 month, N = 15	Speech and language therapy without computer-based tools (usual care), Baseline, N = 15	Speech and language therapy without computer-based tools (usual care), 6 month, N = 15
Person/participant generic health-related quality of life (EuroQol-5D) Scale range: 0-100. Least	NR (NR)	22 (1.95)	NR (NR)	8.7 (1.95)

Outcome	Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet), Baseline, N = 15	Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet), 6 month, N = 15	Speech and language therapy without computer-based tools (usual care), Baseline, N = 15	Speech and language therapy without computer-based tools (usual care), 6 month, N = 15
square mean estimates and standard errors. Mean (SE)				
Communication - impairment specific measures, auditory comprehension (Token test) Scale range: 0-36. Least square mean estimates and standard errors. Mean (SE)	NR (NR)	-7.3 (0.59)	NR (NR)	-2 (0.59)
Psychological distress - depression (Aphasic Depression Rating Scale) Scale range: Unclear. Least square mean estimates and standard errors. Mean (SE)	NR (NR)	6.5 (0.68)	NR (NR)	2.3 (0.68)

Person/participant generic health-related quality of life (EuroQol-5D) - Polarity - Higher values are better
Communication - impairment specific measures, auditory comprehension (Token test) - Polarity - Higher values are better
Psychological distress - depression (Aphasic Depression Rating Scale) - Polarity - Higher values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Person/participantgenerichealth-relatedqualityoflife(EuroQol-5D)-MeanSE-Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,auditorycomprehension(Tokentest)-MeanSE-Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Psychologicaldistress-depression(AphasicDepressionRatingScale)-MeanSE-Computer-based tools for speech and language therapy (virtual reality rehabilitation system-tablet)-Speech and language therapy without computer-based tools (usual care)-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Marshall, 2016

Bibliographic Reference	Marshall, J.; Booth, T.; Devane, N.; Galliers, J.; Greenwood, H.; Hilari, K.; Talbot, R.; Wilson, S.; Woolf, C.; Evaluating the Benefits of Aphasia Intervention Delivered in Virtual Reality: Results of a Quasi-Randomised Study; PLoS ONE [Electronic Resource]; 2016; vol. 11 (no. 8); e0160381

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Quasi- randomised controlled trial
Study location	United Kingdom
Study setting	Data were collected in the participants' homes or at City University London.
Study dates	3rd September 2013 to 29th April 2015
Sources of funding	No additional information.
Inclusion criteria	All had a diagnosis of aphasia following a stroke that occurred at least 4 months prior to the study; they were fluent users of English prior to their stroke (self report); they had no uncorrected visual impairment (self report) and no hearing loss above

	40Db (screened via pure tone audiometry); all had some spoken output (scoring at least 20% correct on the picture naming subtest of the Comprehensive Aphasia Test, CAT).
Exclusion criteria	Severe impairments of speech comprehension (scoring above 70% correct on the CAT test of Spoken Word to Picture Matching, and above chance on the CAT test of Sentence to Picture Matching).
Recruitment / selection of participants	People were recruited from community groups for people with stroke and aphasia across London. They were referred by the group leaders or self-referred.
Intervention(s)	Computer-based tools for speech and language therapy (EVA Park) N=10 EVA Park intervention (online virtual island developed for the OpenSimulator platform where users communicate via speech in real time and received supported language stimulation). They had daily sessions with a support worker (25 sessions in total) each lasting about one hour, supplemented by unlimited independent access. People could visit EVA Park at any time when they might meet and communicate with other participants. Once a week all participants and their support workers met for an hour long group discussion. People accessed EVA Park from their home, using laptops loaned from the University. The intervention included goal setting, some targeting specific aspects of language (such as asking questions, initiating conversation, improving word finding) while others were more context bound (such as ordering food in a restaurant, making a doctor's appointment, enquiring about swimming classes). Intervention was for 7 weeks. Concomitant therapy: No additional information.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered	21-30 hours

using computer tools	
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Combinations of the above
Population subgroups	No additional information.
Comparator	No treatment N=10 Waitlist control group. Concomitant therapy: No additional information.
Number of participants	20
Duration of follow-up	7 weeks - additional follow up information was available at 13 weeks. However, the waiting list group received therapy from the end of the 7 week follow up period, therefore this is not a valid comparison stated in the protocol at 13 weeks.
Indirectness	No additional information.
Additional comments	No additional information.

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Study arms

Computer-based tools for speech and language therapy (EVA Park) (N = 10)

EVA Park intervention (online virtual island developed for the OpenSimulator platform where users communicate via speech in real time and received supported language stimulation). They had daily sessions with a support worker (25 sessions in total) each lasting about one hour, supplemented by unlimited independent access. People could visit EVA Park at any time when they might meet and communicate with other participants. Once a week all participants and their support workers met for an hour long group discussion. People accessed EVA Park from their home, using laptops loaned from the University. The intervention included goal setting, some targeting specific aspects of language (such as asking questions, initiating conversation, improving word finding) while others were more context bound (such as ordering food in a restaurant, making a doctor's appointment, enquiring about swimming classes). Intervention was for 7 weeks. Concomitant therapy: No additional information.

No treatment (N = 10)

Waitlist control group. Concomitant therapy: No additional information.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (EVA Park) (N = 10)	No treatment (N = 10)
% Female Sample size	n = 4 ; % = 40	n = 5 ; % = 50
Mean age (SD) (years) Mean (SD)	59 (13.61)	56.6 (9.73)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR

Characteristic	Computer-based tools for speech and language therapy (EVA Park) (N = 10)	No treatment (N = 10)
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (Months) Mean (SD)	70.1 (68.91)	54.1 (34.46)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA

Outcomes

Study timepoints

- Baseline
- 7 week (<3 months)

Continuous outcomes

Outcome	Computer-based tools for speech and language therapy (EVA Park), Baseline, N = 10	Computer-based tools for speech and language therapy (EVA Park), 7 week, N = 10	No treatment, Baseline, N = 10	No treatment, 7 week, N = 10
Communication - impairment specific measures, naming (verbal fluency)	75.8 (31.42)	82 (38.2)	52.9 (20.89)	62.5 (20.98)

Outcome	Computer-based tools for speech and language therapy (EVA Park), Baseline, N = 10	Computer-based tools for speech and language therapy (EVA Park), 7 week, N = 10	No treatment, Baseline, N = 10	No treatment, 7 week, N = 10
Mean number of items named over 10 categories. Final values. Mean (SD)				
Functional communication (Communication Activities of daily living-2 stanine score) Scale range: unclear. Final values. Mean (SD)	6.5 (1.51)	7.2 (1.55)	6.2 (1.39)	6.1 (1.19)

Communication - impairment specific measures, naming (verbal fluency) - Polarity - Higher values are better
Functional communication (Communication Activities of daily living-2 stanine score) - Polarity - Higher values are better

Dichotomous outcome

Outcome	Computer-based tools for speech and language therapy (EVA Park), Baseline, N = 10	Computer-based tools for speech and language therapy (EVA Park), 7 week, N = 10	No treatment, Baseline, N = 10	No treatment, 7 week, N = 10
Discontinuation No attrition No of events	n = NA ; % = NA	n = 0 ; % = 0	n = NA ; % = NA	n = 0 ; % = 0

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-impairmentspecificmeasures,naming(verbalfluency)-MeanSD-Computer-based tools for speech and language therapy (EVA Park)-No treatment-t7

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Functionalcommunication(CommunicationActivitiesofdailyliving-2staninescore)-MeanSD-Computer-based tools for speech and language therapy (EVA Park)-No treatment-t7

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (EVA Park)-No treatment-t7

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

1 **Marshall, 2020**

Bibliographic Reference	Marshall, J.; Devane, N.; Talbot, R.; Caute, A.; Cruice, M.; Hilari, K.; MacKenzie, G.; Maguire, K.; Patel, A.; Roper, A.; Wilson, S.; A randomised trial of social support group intervention for people with aphasia: A Novel application of virtual reality; PLoS ONE [Electronic Resource]; 2020; vol. 15 (no. 9); e0239715

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3 **Study details**

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	Clinicaltrials.gov = NCT03115268.
Study type	Randomised controlled trial (RCT)
Study location	United Kingdom.
Study setting	Home-based (virtual reality).
Study dates	No additional information.
Sources of funding	Funded by a grant from The Stroke Association. Grant number: TSA 2016/05.
Inclusion criteria	Moderate or mild aphasia; fluent in English before their stroke.
Exclusion criteria	Coexisting diagnosis affecting cognition; severe hearing or visual impairments.

Recruitment / selection of participants	Recruited by project managers from being either existing members of the co-ordinators' community groups or assigned to groups on the basis of their geographical location.
Intervention(s)	Computer-based tools for speech and language therapy (EVA Park) N=16 EVA Park (Firestorm) virtual reality program. Set up training followed a 20 minute protocol and taught each participant how to long in; make their avatar walk, fly and sit; turn on their microphone; adjust the volume of other users and adjust their camera angle. After this 14 sessions were delivered over 6 months. These sessions lasted 1 hour and 30 minutes each (21 hours in total) with sessions occurring once a fortnight. People participated using their computers in their own home. The intervention aimed to counter the negative impacts of aphasia on quality of life and to facilitate living well with aphasia. Activities aimed to promote wellbeing, give participants experiences of communicative success and foster social connection between group members. Each intervention session was based on a topic including those to share experiences of living and coping with aphasia (e.g. 'You', 'Aphasia', 'Resilience', 'Personal Strengths'). Other topics aimed to stimulate social connection and positive communication exchanges (e.g. 'Comedy', 'Music', 'Art', 'Literature' and 'Eating Out'). These included sharing views about the topics, talking about the benefits and experiences of these topics and sometimes reacting to clips/examples of the areas. All sessions aimed to give participants the experience of communication success with formally correct language being not demanded and total communication devices encouraged. These devices included tone of voice, message writing and demonstration. A third type of session was the two 'Project' sessions where people were asked to apply personal strengths in the context of meaningful activities and create something collectively with other group members (e.g. an aphasia awareness film, or an audio podcast about aphasia). Concomitant therapy: Usual care continued for all participants with aphasia for the duration of the study (usual care not defined).
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia

Subgroup 3: Total number of hours of therapy delivered using computer tools	21-30 hours
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Expressive language/communication
Population subgroups	No additional information.
Comparator	No treatment N=18 Waiting list control. Received therapy after 6 months. Therefore, only time points reported before 6 months will be considered for inclusion in this review. Concomitant therapy: Usual care continued for all participants with aphasia for the duration of the study (usual care not defined).
Number of participants	34
Duration of follow-up	6 months (while the delayed group had not received the treatment), 12 months (when the delayed group had also received the intervention).

Additional comments	Intention to treat (carried forward scores for missing data) and per protocol analysis (assessing changes across all participants who completed the intervention and for whom outcome measure data were available).

Study arms

Computer-based tools for speech and language therapy (EVA Park) (N = 16)
EVA Park (Firestorm) virtual reality program. Set up training followed a 20 minute protocol and taught each participant how to long in; make their avatar walk, fly and sit; turn on their microphone; adjust the volume of other users and adjust their camera angle. After this 14 sessions were delivered over 6 months. These sessions lasted 1 hour and 30 minutes each (21 hours in total) with sessions occurring once a fortnight. People participated using their computers in their own home. The intervention aimed to counter the negative impacts of aphasia on quality of life and to facilitate living well with aphasia. Activities aimed to promote wellbeing, give participants experiences of communicative success and foster social connection between group members. Each intervention session was based on a topic including those to share experiences of living and coping with aphasia (e.g. 'You', 'Aphasia', 'Resilience', 'Personal Strengths'). Other topics aimed to stimulate social connection and positive communication exchanges (e.g. 'Comedy', 'Music', 'Art', 'Literature' and 'Eating Out'). These included sharing views about the topics, talking about the benefits and experiences of these topics and sometimes reacting to clips/examples of the areas. All sessions aimed to give participants the experience of communication success with formally correct language being not demanded and total communication devices encouraged. These devices included tone of voice, message writing and demonstration. A third type of session was the two 'Project' sessions where people were asked to apply personal strengths in the context of meaningful activities and create something collectively with other group members (e.g. an aphasia awareness film, or an audio podcast about aphasia). Concomitant therapy: Usual care continued for all participants with aphasia for the duration of the study (usual care not defined).

No treatment (N = 18)
Waiting list control. Received therapy after 6 months. Therefore, only time points reported before 6 months will be considered for inclusion in this review. Concomitant therapy: Usual care continued for all participants with aphasia for the duration of the study (usual care not defined).

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (EVA Park) (N = 16)	No treatment (N = 18)
% Female Sample size	n = 4 ; % = 25	n = 13 ; % = 72.2
Mean age (SD) (years) Median (IQR)	51 (46.5 to 57.5)	65 (51.5 to 71.25)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (Months) Median (IQR)	48 (29.75 to 85.25)	26.5 (11.75 to 79)
Type of communication difficulty Sample size	n = NR ; % = NR	n = NR ; % = NR

Outcomes

Study timepoints

- Baseline
- 6 month (≥3 months. This time period is used as the control group received the intervention at 6 months, therefore in order to investigate the difference between the intervention and no treatment the 6 month time period was the latest time point that could be used.)

Continuous outcomes

Outcome	Computer-based tools for speech and language therapy (EVA Park), Baseline, N = 16	Computer-based tools for speech and language therapy (EVA Park), 6 month, N = 16	No treatment, Baseline, N = 18	No treatment, 6 month, N = 18
Communication - Overall language ability (Western Aphasia Battery - Revised) Scale range: 0-100. Final values. Mean (SD)	78.22 (13.19)	81.86 (12.57)	70.48 (14.64)	71.79 (12.27)
Communication - Functional communication (Communication activities of daily living) Scale range: 0-100. Final values. Mean (SD)	89.37 (7.02)	89.81 (7.61)	81.28 (8.37)	83 (8.49)
Communication related quality of life (SAQoL-39g) Scale range: 1-5. Final values. Mean (SD)	3.78 (0.57)	3.73 (0.72)	3.31 (0.66)	3.35 (0.65)

Communication - Overall language ability (Western Aphasia Battery - Revised) - Polarity - Higher values are better

Communication - Functional communication (Communication activities of daily living) - Polarity - Higher values are better
Communication related quality of life (SAQoL-39g) - Polarity - Higher values are better

Dichotomous outcome

Outcome	Computer-based tools for speech and language therapy (EVA Park), Baseline, N = 16	Computer-based tools for speech and language therapy (EVA Park), 6 month, N = 16	No treatment, Baseline, N = 18	No treatment, 6 month, N = 18
Discontinuation Reasons for withdrawal unclear. Overall reasons included family/health reasons (2), participant obtained employment (1), travel abroad (1), participant recruited by another research project which forbad involvement in this study (2), participant opted to withdraw (1). No of events	n = NA ; % = NA	n = 2 ; % = 12.5	n = NA ; % = NA	n = 1 ; % = 5.6

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-Overalllanguageability(WesternAphasiaBattery-Revised)-MeanSD-Computer-based tools for speech and language therapy (EVA Park)-No treatment-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Functionalcommunication(Communicationactivitiesofdailyliving)-MeanSD-Computer-based tools for speech and language therapy (EVA Park)-No treatment-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communicationrelatedqualityoflife(SAQoL-39g)-MeanSD-Computer-based tools for speech and language therapy (EVA Park)-No treatment-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (EVA Park)-No treatment-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Meltzer, 2018

Bibliographic Reference	Meltzer, J. A.; Baird, A. J.; Steele, R. D.; Harvey, S. J.; Computer-based treatment of poststroke language disorders: a non-inferiority study of telerehabilitation compared to in-person service delivery; Aphasiology; 2018; vol. 32 (no. 3); 290-311

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)
Study location	Canada.
Study setting	Outpatient setting.
Study dates	No additional information.
Sources of funding	The project was supported by a "Telerehabilitation for Stroke" grant from the Heart and Stroke Foundation Canadian Partnership for Stroke Recovery. Matching funds were generously provided by the Manitoba Patient Access Network (MPAN).
Inclusion criteria	A history of unilateral stroke resulting in a communication disorder, occurring at least six months in the past; availability of a communication partner to participate in the treatment program; ability to travel to the treatment site if not at home; ability to hear instructions and operate an iPad tablet to perform homework exercises.
Exclusion criteria	History of dementing illness or other neurological disorder.
Recruitment / selection of participants	People were recruited by advertisements and word of mouth.

Intervention(s)	Computer-based tools for speech and language therapy (telerehabilitation) N=22 Weekly 1 hour sessions with the therapist over 10 weeks received in telerehabilitation conditions. People had an initial 2-hour in person meeting with the therapy team which included collection of medical history, informed consent, initial assessments, goal identification, instruction on using the TalkPath software and random assignment of the person to either treatment group. Remote therapy sessions conducted using teleconferencing equipment and software. People possessing adequate equipment at home consulted the therapist using WebEX, a commercial teleconferencing program, except for one person who preferred to use VSee as they were already familiar with it. Three therapy sessions (weeks 3, 6 and 9) had 30 minutes devoted exclusively to the communication partner, giving training on Supported Conversation techniques and helping the partner keep the client on track with the treatment program. Homework exercises were provided including graded exercises in Speaking, Listening, Reading, Writing and paralinguistic cognitive skills including memory. Other homework items included modified script training, sentence patterning, writing exercises and preparing for specific activities including public speaking events. Concomitant therapy: No additional information.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Mixed Aphasia or cognitive communication
Subgroup 3: Total number of hours of therapy delivered using computer tools	≤10 hours

Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Combinations of the above
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=22 Same therapy principles but delivered in person. Concomitant therapy: No additional information.
Number of participants	44
Duration of follow-up	10 weeks
Indirectness	No additional information.
Additional comments	No additional information.

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Study arms

Computer-based tools for speech and language therapy (telerehabilitation) (N = 22)

Weekly 1 hour sessions with the therapist over 10 weeks received in telerehabilitation conditions. People had an initial 2-hour in person meeting with the therapy team which included collection of medical history, informed consent, initial assessments, goal identification, instruction on using the TalkPath software and random assignment of the person to either treatment group. Remote therapy sessions conducted using teleconferencing equipment and software. People possessing adequate equipment at home consulted the therapist using WebEX, a commercial teleconferencing program, except for one person who preferred to use VSee as they were already familiar with it. Three therapy sessions (weeks 3, 6 and 9) had 30 minutes devoted exclusively to the communication partner, giving training on Supported Conversation techniques and helping the partner keep the client on track with the treatment program. Homework exercises were provided including graded exercises in Speaking, Listening, Reading, Writing and paralinguistic cognitive skills including memory. Other homework items included modified script training, sentence patterning, writing exercises and preparing for specific activities including public speaking events. Concomitant therapy: No additional information.

Speech and language therapy without computer-based tools (usual care) (N = 22)

Same therapy principles but delivered in person. Concomitant therapy: No additional information.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 22)	Speech and language therapy without computer-based tools (usual care) (N = 22)
% Female Sample size	n = 9 ; % = 41	n = 8 ; % = 36
Mean age (SD) (years) Mean (SD)	65.4 (11.3)	63 (10.8)

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 22)	Speech and language therapy without computer-based tools (usual care) (N = 22)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke Mean (SD)	NR (NR)	NR (NR)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA
Broca's aphasia Sample size	n = 4 ; % = 18	n = 6 ; % = 27
Anomic aphasia Sample size	n = 3 ; % = 14	n = 3 ; % = 14
Conduction aphasia Sample size	n = 6 ; % = 27	n = 1 ; % = 5
Global aphasia	n = 2 ; % = 9	n = 2 ; % = 9

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 22)	Speech and language therapy without computer-based tools (usual care) (N = 22)
Sample size		
Wernicke's aphasia Sample size	n = 0 ; % = 0	n = 2 ; % = 9
Mixed transcortical aphasia Sample size	n = 0 ; % = 0	n = 1 ; % = 5
Cognitive-linguistic communication Sample size	n = 5 ; % = 23	n = 6 ; % = 27

Outcomes

Study timepoints

- Baseline
- 10 week (<3 months)

1 ***Continuous outcomes***

Outcome	Computer-based tools for speech and language therapy (telerehabilitation), Baseline, N = 22	Computer-based tools for speech and language therapy (telerehabilitation), 10 week, N = 22	Speech and language therapy without computer-based tools (usual care), Baseline, N = 22	Speech and language therapy without computer-based tools (usual care), 10 week, N = 22
Communication - impairment specific measures, naming (Western Aphasia Battery naming and word finding subscale) Scale range: 0-100. Final values. Mean (SD)	42 (29)	51 (28)	59 (32)	66 (31)
Communication - impairment specific measures, auditory comprehension (Western Aphasia Battery auditory-verbal comprehension) Scale range: 0-200. Final values. Mean (SD)	126 (54)	138 (47)	143 (52)	153 (53)
Communication - Impairment specific measures, Expressive language (Western Aphasia Battery Spontaneous speech) Scale range: 0-20. Final values. Mean (SD)	9.8 (6.2)	11.6 (6.2)	11 (4.4)	12.6 (4.4)

2 Communication - impairment specific measures, naming (Western Aphasia Battery naming and word finding subscale) - Polarity -
3 Higher values are better

Communication - impairment specific measures, auditory comprehension (Western Aphasia Battery auditory-verbal comprehension) - Polarity - Higher values are better
Communication - Impairment specific measures, Expressive language (Western Aphasia Battery Spontaneous speech) - Polarity - Higher values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-impairmentspecificmeasures,naming(WesternAphasiaBatterynamingandwordfindingsubscale)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t10

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,auditorycomprehension(WesternAphasiaBatteryauditory-verbalcomprehension)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t10

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures,Expressivelanguage(WesternAphasiaBatterySpontaneousspeech)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t10

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Mitchell, 2018

Bibliographic Reference	Mitchell, C.; Bowen, A.; Tyson, S.; Conroy, P.; ReaDySpeech for people with dysarthria after stroke: protocol for a feasibility randomised controlled trial; Pilot & Feasibility Studies; 2018; vol. 4; 25

Study details

Secondary publication of another included study- see primary study for details	Mitchell, C., Bowen, A., Tyson, S. et al. (2018) A feasibility randomized controlled trial of ReaDySpeech for people with dysarthria after stroke. Clinical rehabilitation 32(8): 1037-1046
Other publications associated with this study included in review	No additional information

Mitchell, 2018

Bibliographic Reference	Mitchell, C.; Bowen, A.; Tyson, S.; Conroy, P.; A feasibility randomized controlled trial of ReaDySpeech for people with dysarthria after stroke; Clinical rehabilitation; 2018; vol. 32 (no. 8); 1037-1046

Study details

Secondary publication of another included study- see primary study for details	No additional information
Other publications associated with this study included in review	Mitchell, C., Bowen, A., Tyson, S. et al. (2018) ReaDySpeech for people with dysarthria after stroke: protocol for a feasibility randomised controlled trial. Pilot & Feasibility Studies 4: 25
Trial name / registration number	ISRCTN84996500
Study type	Randomised controlled trial (RCT)
Study location	United Kingdom
Study setting	Hospital and community-based stroke services
Study dates	No additional information.
Sources of funding	This project is funded by the NIHR Doctoral Training Program (project no. DRF-2014-07-043).
Inclusion criteria	People with post-stroke dysarthria; more than one week post stroke (no upper limit); medically stable; considered by their speech and language therapist as likely to benefit from intervention; sufficient English language skills to participate in therapy without a translator. People with co-occurring aphasia were eligible and were only excluded if treatment speech and language therapist felt that severity precluded the use of ReaDySpeech.

Exclusion criteria	Co-existing progressive neurological conditions or cognitive hearing or visual problems that prevented use of ReaDySpeech as judged by the treating speech and language therapist who sought advice or further opinion from other health professionals if in doubt.
Recruitment / selection of participants	People from four hospital and community-based stroke services in England over 14 months.
Intervention(s)	Computer-based tools for speech and language therapy (ReaDySpeech) N=26 ReaDySpeech, an online computer programme, delivered in any way considered clinically appropriate by the treating therapist. ReaDySpeech was accessible using any Wi-Fi enabled device. It included activities for articulation, breathing, rate of speech, volume, facial expression, intonation and oro-motor exercises. The activities were shown through video clips, instructions appearing on-screen and words, sentences or phrases appearing on-screen. Exercises were set by the therapist specific to each person's need and amended according to progress. The program provided feedback on the completion of exercises but not on the quality of speech production. The programme could be used during face-to-face therapy sessions with a therapist initially and thereafter with an assistant, supported by family or independent practice. Although it was expected to be over 8 to 10 weeks, there was no specified intensity or duration. Concomitant therapy: No additional information.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Dysarthria
Subgroup 3: Total number of hours of therapy delivered	Mixed Intensity and duration could be varied.

using computer tools	
Subgroup 4: Time after stroke at the start of the trial	Subacute (7 days - 6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Articulation therapy
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=14 Usual care which would vary by site, from no intervention to best practice guidelines. This could include the following: specific exercises for speech muscles, breathing, articular work; strategies such as slowing speech, communication aids such as alphabet charts or text-to-talk aids, education about dysarthria and/or awareness training and psychological support or advice and/or strategies to communication partners. Concomitant therapy: No additional information.
Number of participants	40
Duration of follow-up	10 weeks (end of intervention).
Indirectness	No additional information.

Additional comments	Intention-to-treat.

Study arms

Computer-based tools for speech and language therapy (ReaDySpeech) (N = 26)

ReaDySpeech, an online computer programme, delivered in any way considered clinically appropriate by the treating therapist. ReaDySpeech was accessible using any Wi-Fi enabled device. It included activities for articulation, breathing, rate of speech, volume, facial expression, intonation and oro-motor exercises. The activities were shown through video clips, instructions appearing on-screen and words, sentences or phrases appearing on-screen. Exercises were set by the therapist specific to each person's need and amended according to progress. The program provided feedback on the completion of exercises but not on the quality of speech production. The programme could be used during face-to-face therapy sessions with a therapist initially and thereafter with an assistant, supported by family or independent practice. Although it was expected to be over 8 to 10 weeks, there was no specified intensity or duration. Concomitant therapy: No additional information.

Speech and language therapy without computer-based tools (usual care) (N = 14)

Usual care which would vary by site, from no intervention to best practice guidelines. This could include the following: specific exercises for speech muscles, breathing, articular work; strategies such as slowing speech, communication aids such as alphabet charts or text-to-talk aids, education about dysarthria and/or awareness training and psychological support or advice and/or strategies to communication partners. Concomitant therapy: No additional information.

1 **Characteristics**

2 ***Arm-level characteristics***

Characteristic	Computer-based tools for speech and language therapy (ReaDySpeech) (N = 26)	Speech and language therapy without computer-based tools (usual care) (N = 14)
% Female Sample size	n = 8 ; % = 31	n = 2 ; % = 14
Mean age (SD) (years) Range	37 to 99	55 to 85
Mean age (SD) (years) Mean (SD)	70 (NR)	67 (NR)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (days) Range	8 to 67	8 to 90
Time after stroke (days) Mean (SD)	24 (NR)	27 (NR)

Characteristic	Computer-based tools for speech and language therapy (ReaDySpeech) (N = 26)	Speech and language therapy without computer-based tools (usual care) (N = 14)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA
Dysarthria Sample size	n = 26 ; % = 100	n = 14 ; % = 100
Aphasia present Sample size	n = 2 ; % = 8	n = 2 ; % = 14

Outcomes

Study timepoints

- Baseline
- 10 week (<3 months)

Continuous outcomes

Outcome	Computer-based tools for speech and language therapy (ReaDySpeech), Baseline, N = 26	Computer-based tools for speech and language therapy (ReaDySpeech), 10 week, N = 23	Speech and language therapy without computer-based tools (usual care), Baseline, N = 14	Speech and language therapy without computer-based tools (usual care), 10 week, N = 14
Communication - impairment specific measures, speech	153 (43.3)	177 (38.6)	170 (20.2)	184 (20.4)

Outcome	Computer-based tools for speech and language therapy (ReaDySpeech), Baseline, N = 26	Computer-based tools for speech and language therapy (ReaDySpeech), 10 week, N = 23	Speech and language therapy without computer-based tools (usual care), Baseline, N = 14	Speech and language therapy without computer-based tools (usual care), 10 week, N = 14
impairment (Dysarthria) (Frenchay Dysarthria Assessment-II) Scale range: Unclear. Final values. Mean (SD)				
Communication - impairment specific measures, activity (Dysarthria) (Dysarthria Therapy Outcome Measures) Scale range: Unclear. Final values. Mean (SD)	3.2 (1.1)	3.6 (1.1)	3.5 (0.8)	3.9 (0.6)
Communication related quality of life (COAST) Scale range: 0-100. Final values. Mean (SD)	56 (16.7)	65.3 (16.6)	63.1 (15)	71 (15.3)

Communication - impairment specific measures, speech impairment (Dysarthria) (Frenchay Dysarthria Assessment-II) - Polarity - Higher values are better
Communication - impairment specific measures, activity (Dysarthria) (Dysarthria Therapy Outcome Measures) - Polarity - Higher values are better
Communication related quality of life (COAST) - Polarity - Higher values are better

Dichotomous outcome

Outcome	Computer-based tools for speech and language therapy (ReaDySpeech), Baseline, N = 26	Computer-based tools for speech and language therapy (ReaDySpeech), 10 week, N = 26	Speech and language therapy without computer-based tools (usual care), Baseline, N = 14	Speech and language therapy without computer-based tools (usual care), 10 week, N = 14
Discontinuation Intervention: 3 withdrew before intervention. 1 refused intervention. 1 had another stroke, too unwell. 1 technical issues. 4 staffing unable to support. No of events	n = NA ; % = NA	n = 10 ; % = 38	n = NA ; % = NA	n = 0 ; % = 0

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-impairmentspecificmeasures,speechimpairment(Dysarthria)(FrenchayDysarthriaAssessment-II)-MeanSD-Computer-based tools for speech and language therapy (ReaDySpeech)-Speech and language therapy without computer-based tools (usual care)-t10

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,activity(Dysarthria)(DysarthriaTherapyOutcomeMeasures)-MeanSD-Computer-based tools for speech and language therapy (ReaDySpeech)-Speech and language therapy without computer-based tools (usual care)-t10

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communicationrelatedqualityoflife(COAST)-MeanSD-Computer-based tools for speech and language therapy (ReaDySpeech)-Speech and language therapy without computer-based tools (usual care)-t10

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Withdrawalduetoadverseevents-NoOfEvents-Computer-based tools for speech and language therapy (ReaDySpeech)-Speech and language therapy without computer-based tools (usual care)-t10

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

1 **Ora, 2020**

Bibliographic Reference	Ora, H. P.; Kirmess, M.; Brady, M. C.; Partee, I.; Hognestad, R. B.; Johannessen, B. B.; Thommessen, B.; Becker, F.; The effect of augmented speech-language therapy delivered by telerehabilitation on poststroke aphasia-a pilot randomized controlled trial; Clinical Rehabilitation; 2020; vol. 34 (no. 3); 369-381

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3 **Study details**

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	Ora, H. P., Kirmess, M., Brady, M. C. et al. (2018) Telerehabilitation for aphasia - protocol of a pragmatic, exploratory, pilot randomized controlled trial. Trials [Electronic Resource] 19(1): 208
Trial name / registration number	Clinicaltrials.gov = NCT02768922.
Study type	Randomised controlled trial (RCT)
Study location	Norway
Study setting	Outpatient follow up.
Study dates	May 2016 to May 2018.
Sources of funding	Funded by the South-Eastern Norway Regional Health Authority (project number 2015037) and has also received financial support from the University of Oslo and Sunnaas Rehabilitation Hospital. The NMAHP RU and MB is supported by the Chief Scientist Office, part of the Scottish Government Health and Social Care Directorates.
Inclusion criteria	People with aphasia following stroke (any time post stroke); aphasia including naming impairment (percentile score of 70 or lower on the Norwegian Basic Aphasia Assessment subtest naming); Norwegian was their main language.

Exclusion criteria	Age below 16 years; people who were unable to perform five hours of speech-language therapy per week due to medical or cognitive reasons (including moderate to severe hearing or visual impairment); people who scored >70 percentile score on the Norwegian Basic Aphasia Assessment subtest naming; people with traumatic brain injury.
Recruitment / selection of participants	People recruited within the Oslo region from stroke units at four different hospitals, from rehabilitation institutions including Sunnaas Rehabilitation Hospital and from cooperating speech-language pathologists.
Intervention(s)	Computer-based tools for speech and language therapy (telerehabilitation) N=32 Additional telerehabilitation receiving augmented language training via videoconference. This included different impairment-based methods like functional-oriented therapy to phonological, semantic, cognitive-linguistic and cognitive-neuropsychological approaches. The therapy was tailored to the individual participant's language impairment, needs and goals in all language modalities (reading, writing, spoken language and auditory comprehension). People were required to complete at least 16 sessions of speech-language therapy via videoconference over 32 days in order to secure therapy time as defined per protocol. On average telerehabilitation was completed for 18.6 (1.5) hours. Concomitant therapy: All people received usual care from local speech-language pathologists at the community level and/or in a rehabilitation institution. The dosage was measured by hours from inclusion to follow-up assessment. On average usual care was completed for 20.4 (12.0) hours and 25.0 (13.8) hours for the intervention and control group respectively.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered	11-20 hours

using computer tools	
Subgroup 4: Time after stroke at the start of the trial	Mixed
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Combinations of the above
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=30 Usual care only. Concomitant therapy: All people received usual care from local speech-language pathologists at the community level and/or in a rehabilitation institution. The dosage was measured by hours from inclusion to follow-up assessment. On average usual care was completed for 20.4 (12.0) hours and 25.0 (13.8) hours for the intervention and control group respectively.
Number of participants	62
Duration of follow-up	4 weeks (end of intervention), 4 months
Indirectness	No additional information.
Additional comments	Intention-to-treat analysis.

Study arms

Computer-based tools for speech and language therapy (telerehabilitation) (N = 32)

Additional telerehabilitation receiving augmented language training via videoconference. This included different impairment-based methods like functional-oriented therapy to phonological, semantic, cognitive-linguistic and cognitive-neuropsychological approaches. The therapy was tailored to the individual participant's language impairment, needs and goals in all language modalities (reading, writing, spoken language and auditory comprehension). People were required to complete at least 16 sessions of speech-language therapy via videoconference over 32 days in order to secure therapy time as defined per protocol. On average telerehabilitation was completed for 18.6 (1.5) hours. Concomitant therapy: All people received usual care from local speech-language pathologists at the community level and/or in a rehabilitation institution. The dosage was measured by hours from inclusion to follow-up assessment. On average usual care was completed for 20.4 (12.0) hours and 25.0 (13.8) hours for the intervention and control group respectively.

Speech and language therapy without computer-based tools (usual care) (N = 30)

Usual care only. Concomitant therapy: All people received usual care from local speech-language pathologists at the community level and/or in a rehabilitation institution. The dosage was measured by hours from inclusion to follow-up assessment. On average usual care was completed for 20.4 (12.0) hours and 25.0 (13.8) hours for the intervention and control group respectively.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 32)	Speech and language therapy without computer-based tools (usual care) (N = 30)
% Female Sample size	n = 13 ; % = 40.6	n = 8 ; % = 26.7

Characteristic	**Computer-based tools for speech and language therapy (telerehabilitation) (N = 32)**	**Speech and language therapy without computer-based tools (usual care) (N = 30)**
Mean age (SD) (years) Mean (SD)	64.7 (11.7)	65 (12.2)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke Sample size	n = NA ; % = NA	n = NA ; % = NA
Less than or equal to 3 months Sample size	n = 16 ; % = 50	n = 12 ; % = 40
3-12 months Sample size	n = 5 ; % = 15.6	n = 4 ; % = 13.3
12 months Sample size	n = 11 ; % = 34.4	n = 14 ; % = 46.7

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 32)	Speech and language therapy without computer-based tools (usual care) (N = 30)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA

Outcomes

Study timepoints

- Baseline
- 4 week (<3 months)
- 4 month (≥3 months)

Continuous outcomes

Outcome	Computer-based tools for speech and language therapy (telerehabilitation), Baseline, N = 32	Computer-based tools for speech and language therapy (telerehabilitation), 4 week, N = 32	Computer-based tools for speech and language therapy (telerehabilitation), 4 month, N = 32	Speech and language therapy without computer-based tools (usual care), Baseline, N = 30	Speech and language therapy without computer-based tools (usual care), 4 week, N = 30	Speech and language therapy without computer-based tools (usual care), 4 month, N = 30
Communication - Impairment specific measures (Naming) (NGA subtest	38.9 (13.7)	47.3 (18.9)	50.4 (22.4)	45 (17.6)	50.2 (23.3)	54.1 (24.9)

Outcome	Computer-based tools for speech and language therapy (telerehabilitation), Baseline, N = 32	Computer-based tools for speech and language therapy (telerehabilitation), 4 week, N = 32	Computer-based tools for speech and language therapy (telerehabilitation), 4 month, N = 32	Speech and language therapy without computer-based tools (usual care), Baseline, N = 30	Speech and language therapy without computer-based tools (usual care), 4 week, N = 30	Speech and language therapy without computer-based tools (usual care), 4 month, N = 30
naming) Scale range: 0-100. Final values. Mean (SD)						
Communication - Impairment specific measures (Auditory Comprehension) (NGA subtest comprehension) Scale range: 0-100. Final values. Mean (SD)	47.6 (19.8)	59.3 (23.3)	61 (24)	52.8 (24)	59.2 (28.5)	61.5 (29.5)

Communication - Impairment specific measures (Naming) (NGA subtest naming) - Polarity - Higher values are better
Communication - Impairment specific measures (Auditory Comprehension) (NGA subtest comprehension) - Polarity - Higher values are better

Dichotomous outcome

Outcome	Computer-based tools for speech and language therapy (telerehabilitation), Baseline, N = 32	Computer-based tools for speech and language therapy (telerehabilitation), 4 week, N = 32	Computer-based tools for speech and language therapy (telerehabilitation), 4 month, N = 32	Speech and language therapy without computer-based tools (usual care), Baseline, N = 30	Speech and language therapy without computer-based tools (usual care), 4 week, N = 30	Speech and language therapy without computer-based tools (usual care), 4 month, N = 30
Discontinuation Intervention: 1 withdrew, 1 died. 1 lost at 4 months as unable to attend due to hospitalisation. Control: 3 withdrew. No of events	n = NA ; % = NA	n = 2 ; % = 6	n = 3 ; % = 9	n = NA ; % = NA	n = 3 ; % = 10	n = 3 ; % = 10

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-Impairmentspecificmeasures(Naming)(NGAsubtestnaming)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low

Section	Question	Answer
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures(Naming)(NGAsubtestnaming)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t4 months

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures(AuditoryComprehension)(NGAsubtestcomprehension)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Impairmentspecificmeasures(AuditoryComprehension)(NGAsubtestcomprehension)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t4 months

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low

Section	Question	Answer
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t4

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t4 months

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Ora, 2018

Bibliographic Reference	Ora, H. P.; Kirmess, M.; Brady, M. C.; Winsnes, I. E.; Hansen, S. M.; Becker, F.; Telerehabilitation for aphasia - protocol of a pragmatic, exploratory, pilot randomized controlled trial; Trials [Electronic Resource]; 2018; vol. 19 (no. 1); 208

Study details

Secondary publication of another included study- see primary study for details	Ora, H. P., Kirmess, M., Brady, M. C. et al. (2020) The effect of augmented speech-language therapy delivered by telerehabilitation on poststroke aphasia-a pilot randomized controlled trial. Clinical Rehabilitation 34(3): 369-381
Other publications associated with this study included in review	No additional information.

Palmer, 2015

Bibliographic Reference	Palmer, R.; Cooper, C.; Enderby, P.; Brady, M.; Julious, S.; Bowen, A.; Latimer, N.; Clinical and cost effectiveness of computer treatment for aphasia post stroke (Big CACTUS): study protocol for a randomised controlled trial; Trials [Electronic Resource]; 2015; vol. 16; 18

Study details

Secondary publication of another included study- see primary study for details	Palmer, R., Dimairo, M., Cooper, C. et al. (2019) 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. Lancet Neurology 18(9): 821-833

Palmer, 2019

Bibliographic Reference	Palmer, R.; Dimairo, M.; Cooper, C.; Enderby, P.; Brady, M.; Bowen, A.; Latimer, N.; Julious, S.; Cross, E.; Alshreef, A.; Harrison, M.; Bradley, E.; Witts, H.; Chater, T.; 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; Lancet Neurology; 2019; vol. 18 (no. 9); 821-833

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	Latimer, N. R., Bhadhuri, A., Alshreef, A. et al. (2021) Self-managed, computerised word finding therapy as an add-on to usual care for chronic aphasia post-stroke: An economic evaluation. Clinical Rehabilitation 35(5): 703-717 Palmer, R., Cooper, C., Enderby, P. et al. (2015) Clinical and cost effectiveness of computer treatment for aphasia post stroke (Big CACTUS): study protocol for a randomised controlled trial. Trials [Electronic Resource] 16: 18 Palmer, R., Dimairo, M., Latimer, N. et al. (2020) Computerised speech and language therapy or attention control added to usual care for people with long-term post-stroke aphasia: the Big CACTUS three-arm RCT. Health Technology Assessment (Winchester, England) 24(19): 1-176
Trial name / registration number	ISRCTN: ISRCTN68798818.
Study type	Randomised controlled trial (RCT)
Study location	United Kingdom.
Study setting	Outpatient at speech and language therapy departments.
Study dates	October 20th 2014 to August 18th 2016.

Sources of funding	National Institute for Health Research, Tavistock Trust for Aphasia.
Inclusion criteria	18 years or older and had aphasia confirmed by a speech and language therapist after one or more strokes at least 4 months before randomisation; people had word finding difficulties (defined by a score of 5-43 out of 48 on the Comprehensive Aphasia Test Naming Objects test); could perform a simple matching task on the StepByStep computer program with at least 50% accuracy (score of 5 out of 10 or higher) and could repeat at least 50% of words in a repetition task on StepByStep (score of 5 out of 10 or higher).
Exclusion criteria	Premorbid speech and language disorder caused by a neurological deficit other than stroke; required treatment for a language other than English (because the StepByStep software used for therapy was in English); they were currently using a word finding computer program, including StepByStep.
Recruitment / selection of participants	Recruited from 21 speech and language therapy departments in the United Kingdom.
Intervention(s)	Computer-based tools for speech and language therapy (Computer speech and language therapy) N=97 Computer speech and language therapy group completed daily, self-managed, word-finding exercises on a computer at home, which were tailored to the needs of the individual patient by a qualified speech and language therapist experienced in working with patients with stroke in routine clinical practice. Each person chose 100 words that were relevant to them, before they were randomly assigned to one of the intervention groups, which were then used for computerised word finding practice. Practice was supported by a therapy assistant or volunteer under the supervision of the therapist for 6 months. If they wished, people were able to continue this after 6 months. Concomitant therapy: All people received usual care. Usual care constituted speech and language therapy amount recorded for 3 months before people who had chronic aphasia longer than 4 months after stroke were randomised.
Subgroup 1: Severity of communication difficulty (as stated by category)	Mixed

Subgroup 2: Type of communication difficulty	Mixed All had aphasia. Around 35% had apraxia of speech.
Subgroup 3: Total number of hours of therapy delivered using computer tools	Not stated/unclear
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Mixed
Subgroup 6: Method of therapy	Word finding therapy
Population subgroups	No additional information.
Comparator	Social support/stimulation (attention control) N=80 Paper-based puzzle book activities (e.g. sudoku, spot the difference, word searches or colouring) on a daily basis and received supportive telephone calls from the research team once a month. The type and difficulty of the puzzle book was established by the therapist who did the baseline assessments and the research team sent new books each month on the basis of the phone call discussions. If they wished, people were able to continue this after 6 months by purchasing items from high-street shops.

	Concomitant therapy: All people received usual care. Usual care constituted speech and language therapy amount recorded for 3 months before people who had chronic aphasia longer than 4 months after stroke were randomised. Speech and language therapy without computer-based tools (usual care) N=101 Usual care only. Concomitant therapy: All people received usual care. Usual care constituted speech and language therapy amount recorded for 3 months before people who had chronic aphasia longer than 4 months after stroke were randomised.
Number of participants	278
Duration of follow-up	12 months
Indirectness	No additional information.
Additional comments	Modified Intention to treat (people who gave informed consent while excluding those without 6-month outcome measures).

Study arms

Computer-based tools for speech and language therapy (Computer speech and language therapy) (N = 97)

Computer speech and language therapy group completed daily, self-managed, word-finding exercises on a computer at home, which were tailored to the needs of the individual patient by a qualified speech and language therapist experienced in working with patients with stroke in routine clinical practice. Each person chose 100 words that were relevant to them, before they were randomly assigned to one of the intervention groups, which were then used for computerised word finding practice. Practice was supported by a therapy assistant or volunteer under the supervision of the therapist for 6 months. If they wished, people were able to continue this after 6 months. Concomitant therapy: All people received usual care. Usual care constituted speech and language therapy amount recorded for 3 months before people who had chronic aphasia longer than 4 months after stroke were randomised.

Social support/stimulation (attention control) (N = 80)

Paper-based puzzle book activities (e.g. sudoku, spot the difference, word searches or colouring) on a daily basis and received supportive telephone calls from the research team once a month. The type and difficulty of the puzzle book was established by the therapist who did the baseline assessments and the research team sent new books each month on the basis of the phone call discussions. If they wished, people were able to continue this after 6 months by purchasing items from high-street shops. Concomitant therapy: All people received usual care. Usual care constituted speech and language therapy amount recorded for 3 months before people who had chronic aphasia longer than 4 months after stroke were randomised.

Speech and language therapy without computer-based tools (usual care) (N = 101)

Usual care only. Concomitant therapy: All people received usual care. Usual care constituted speech and language therapy amount recorded for 3 months before people who had chronic aphasia longer than 4 months after stroke were randomised.

Characteristics

Arm-level characteristics

Characteristic	**Computer-based tools for speech and language therapy (Computer speech and language therapy) (N = 97)**	**Social support/stimulation (attention control) (N = 80)**	**Speech and language therapy without computer-based tools (usual care) (N = 101)**
% Female Sample size	n = 39 ; % = 41.5	n = 30 ; % = 38	n = 37 ; % = 38.1
Mean age (SD) (years) Mean (SD)	65.6 (12.7)	64.8 (13.1)	65.6 (13.1)
Ethnicity	n = NR ; % = NR	n = NR ; % = NR	n = NR ; % = NR

Characteristic	Computer-based tools for speech and language therapy (Computer speech and language therapy) (N = 97)	Social support/stimulation (attention control) (N = 80)	Speech and language therapy without computer-based tools (usual care) (N = 101)
Sample size			
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR	n = NR ; % = NR
Severity Severity of word finding difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA	n = NA ; % = NA
Mild Sample size	n = 41 ; % = 43.6	n = 38 ; % = 48.1	n = 40 ; % = 41.2
Moderate Sample size	n = 28 ; % = 28.9	n = 19 ; % = 24.1	n = 37 ; % = 36.6
Severe Sample size	n = 25 ; % = 26.6	n = 22 ; % = 27.8	n = 24 ; % = 24.7
Time after stroke (years) Mean (SD)	2.8 (2.9)	3.4 (4.6)	2.8 (2.7)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA	n = NA ; % = NA

Characteristic	Computer-based tools for speech and language therapy (Computer speech and language therapy) (N = 97)	Social support/stimulation (attention control) (N = 80)	Speech and language therapy without computer-based tools (usual care) (N = 101)
Anomic aphasia Sample size	n = 35 ; % = 37.2	n = 22 ; % = 27.8	n = 39 ; % = 40.2
Non-fluent (Brocha's) aphasia Sample size	n = 38 ; % = 40.4	n = 29 ; % = 36.7	n = 40 ; % = 41.2
Mixed non-fluent aphasia Sample size	n = 15 ; % = 16	n = 21 ; % = 26.6	n = 13 ; % = 13.4
Fluent (Wernicke's) aphasia Sample size	n = 6 ; % = 6.4	n = 7 ; % = 8.9	n = 5 ; % = 5.2
Evidence of apraxia of speech Sample size	n = 32 ; % = 34	n = 31 ; % = 39.2	n = 33 ; % = 34

Outcomes

Study timepoints

- Baseline
- 12 month (≥3 months)

1

2 ***Continuous outcomes***

Outcome	Computer-based tools for speech and language therapy (Computer speech and language therapy), Baseline, N = 94	Computer-based tools for speech and language therapy (Computer speech and language therapy), 12 month, N = 94	Social support/stimulation (attention control), Baseline, N = 79	Social support/stimulation (attention control), 12 month, N = 79	Speech and language therapy without computer-based tools (usual care), Baseline, N = 97	Speech and language therapy without computer-based tools (usual care), 12 month, N = 97
Communication - impairment specific measures, naming (word finding ability) (%) Scale range: 0-100. Change scores. Mean (SD)	43.2 (19)	16.1 (16.6)	41.4 (20.7)	7.7 (13.4)	42.8 (18.1)	5.2 (16)
Communication - functional communication (TOMS) Scale range: 0-10. Change scores. Mean (SD)	2.9 (1.2)	0.12 (0.74)	2.7 (1)	0.09 (0.89)	3.1 (1)	0.13 (0.79)
Communication related quality of life (COAST) (%)	58.2 (13.6)	5.3 (13.9)	60 (13.8)	3.4 (14.2)	59.9 (13.1)	7.4 (13.7)

Outcome	Computer-based tools for speech and language therapy (Computer speech and language therapy), Baseline, N = 94	Computer-based tools for speech and language therapy (Computer speech and language therapy), 12 month, N = 94	Social support/stimulation (attention control), Baseline, N = 79	Social support/stimulation (attention control), 12 month, N = 79	Speech and language therapy without computer-based tools (usual care), Baseline, N = 97	Speech and language therapy without computer-based tools (usual care), 12 month, N = 97
Scale range: 0-100. Change scores. Mean (SD)						

1 Communication - impairment specific measures, naming (word finding ability) - Polarity - Higher values are better
2 Communication - functional communication (TOMS) - Polarity - Higher values are better
3 Communication related quality of life (COAST) - Polarity - Higher values are better

4 ***Continuous outcome (person/participant generic health related quality of life)***

Outcome	Computer-based tools for speech and language therapy (Computer speech and language therapy), Baseline, N = 97	Computer-based tools for speech and language therapy (Computer speech and language therapy), 12 month, N = 97	Social support/stimulation (attention control), Baseline, N = 80	Social support/stimulation (attention control), 12 month, N = 80	Speech and language therapy without computer-based tools (usual care), Baseline, N = 101	Speech and language therapy without computer-based tools (usual care), 12 month, N = 101
Person/participant generic health-related quality of life (EQ-5D-5L index)	0.61 (0.24)	0.59 (0.25)	0.59 (0.26)	0.59 (0.24)	0.63 (0.23)	0.65 (0.23)

Outcome	Computer-based tools for speech and language therapy (Computer speech and language therapy), Baseline, N = 97	Computer-based tools for speech and language therapy (Computer speech and language therapy), 12 month, N = 97	Social support/stimulation (attention control), Baseline, N = 80	Social support/stimulation (attention control), 12 month, N = 80	Speech and language therapy without computer-based tools (usual care), Baseline, N = 101	Speech and language therapy without computer-based tools (usual care), 12 month, N = 101
Scale range: -0.11-1. Final values. Mean (SD)						

1 Person/participant generic health-related quality of life (EQ-5D-5L index) - Polarity - Higher values are better

2 ***Dichotomous outcome***

Outcome	Computer-based tools for speech and language therapy (Computer speech and language therapy), Baseline, N = 97	Computer-based tools for speech and language therapy (Computer speech and language therapy), 12 month, N = 97	Social support/stimulation (attention control), Baseline, N = 80	Social support/stimulation (attention control), 12 month, N = 80	Speech and language therapy without computer-based tools (usual care), Baseline, N = 101	Speech and language therapy without computer-based tools (usual care), 12 month, N = 101
Discontinuation Computer: 3 died, 18 withdrew consent, 3 investigator decision. Social support: 1 died, 13 withdrew consent, 3 lost to	n = NA ; % = NA	n = 24 ; % = 25	n = NA ; % = NA	n = 17 ; % = 21	n = NA ; % = NA	n = 17 ; % = 17

Outcome	Computer-based tools for speech and language therapy (Computer speech and language therapy), Baseline, N = 97	Computer-based tools for speech and language therapy (Computer speech and language therapy), 12 month, N = 97	Social support/stimulation (attention control), Baseline, N = 80	Social support/stimulation (attention control), 12 month, N = 80	Speech and language therapy without computer-based tools (usual care), Baseline, N = 101	Speech and language therapy without computer-based tools (usual care), 12 month, N = 101
follow-up. Usual care: 4 died, 10 withdrew consent, 2 lost to follow-up, 1 investigator decision. No of events						

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-impairmentspecificmeasures,naming(wordfindingability)-MeanSD-Computer-based tools for speech and language therapy (Computer speech and language therapy)-Social support/stimulation (attention control)-Speech and language therapy without computer-based tools (usual care)-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-functionalcommunication(TOMS)-MeanSD-Computer-based tools for speech and language therapy (Computer speech and language therapy)-Social support/stimulation (attention control)-Speech and language therapy without computer-based tools (usual care)-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communicationrelatedqualityoflife(COAST)-MeanSD-Computer-based tools for speech and language therapy (Computer speech and language therapy)-Social support/stimulation (attention control)-Speech and language therapy without computer-based tools (usual care)-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcome(person/participantgenerichealthrelatedqualityoflife)-Person/participantgenerichealth-relatedqualityoflife(EQ-5D-5Lindex)-MeanSD-Computer-based tools for speech and language therapy (Computer speech and language therapy)-Social support/stimulation (attention control)-Speech and language therapy without computer-based tools (usual care)-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (Computer speech and language therapy)-Social support/stimulation (attention control)-Speech and language therapy without computer-based tools (usual care)-t12

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Palmer, 2020

Bibliographic Reference	Palmer, R.; Dimairo, M.; Latimer, N.; Cross, E.; Brady, M.; Enderby, P.; Bowen, A.; Julious, S.; Harrison, M.; Alshreef, A.; Bradley, E.; Bhadhuri, A.; Chater, T.; Hughes, H.; Witts, H.; Herbert, E.; Cooper, C.; Computerised speech and language therapy or attention control added to usual care for people with long-term post-stroke aphasia: the Big CACTUS three-arm RCT; Health Technology Assessment (Winchester, England); 2020; vol. 24 (no. 19); 1-176

Study details

Secondary publication of another included study- see primary study for details	Palmer, R., Dimairo, M., Cooper, C. et al. (2019) 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. Lancet Neurology 18(9): 821-833

Palmer, 2012

Bibliographic Reference	Palmer, R.; Enderby, P.; Cooper, C.; Latimer, N.; Julious, S.; Paterson, G.; Dimairo, M.; Dixon, S.; Mortley, J.; Hilton, R.; Delaney, A.; Hughes, H.; Computer therapy compared with usual care for people with long-standing aphasia poststroke: a pilot randomized controlled trial; Stroke; 2012; vol. 43 (no. 7); 1904-11

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	Latimer, N. R.; Dixon, S.; Palmer, R. (2013) Cost-utility of self-managed computer therapy for people with aphasia. International Journal of Technology Assessment in Health Care 29(4): 402-9
Trial name / registration number	ISRCTN91534629.
Study type	Randomised controlled trial (RCT)
Study location	United Kingdom.
Study setting	Outpatient follow up.
Study dates	No additional information.
Sources of funding	Independent research commissioned by the National Institute for Health Research (NIHR) under its Research for Patient Benefit (RfPB) Programme (Grant Reference Number PB-PG-1207-14097). This study was also supported by the Stroke and Telehealth themes of the South Yorkshire Collaboration for Leadership in applied health research and care (CLAHRC). NIHR CLAHRC) for South Yorkshire acknowledges funding from the National Institute of Health Research. The study also received support from the North of Tyne Primary Care Trust.

Inclusion criteria	Diagnosis of stroke and aphasia with word-finding difficulties as 1 of the predominant features as assessed by the Comprehensive Aphasia Test and the Object and Action Naming Battery; had the ability to repeat spoken words presented by the recruiting speech and language therapist; no longer received impairment-focussed speech and language therapy to enable the computer treatment to be better isolated and evaluated. People with motor deficits were not excluded and where there were barriers to using the computer hardware, assistive devices such as tracker balls or touch screen computers were offered.
Exclusion criteria	People with severe visual or cognitive difficulties reducing ability to use the computer program.
Recruitment / selection of participants	Local support groups and speech and language therapy department records in South Yorkshire and Newcastle & North Tyneside, UK.
Intervention(s)	Computer-based tools for speech and language therapy (StepbyStep computer program) N=17 StepbyStep computer program in addition to usual language activities. The program contains a library of >13000 language exercises. Photographic images can be added to enable practice of personally relevant words such as names of people and pets. Each exercise follows steps progressing from listening to target words, producing words with visual, semantic, phonemic or written letter/word cues through to saying the words in sentences. This was configured by a speech and language therapist and supported by a volunteer. Volunteers contacted the person once a week in the first month and at least once a month thereafter by telephone or home visit. Independent practice was advised for at least 20 minutes, 3 days a week for 5 months (approximately 1500 minutes of practice time in total). Concomitant therapy: All people participated in activities that provide general language stimulation as they had done previously including attendance at communication support groups and conversation, reading and writing activities that were a part of everyday life.
Subgroup 1: Severity of communication difficulty (as stated by category)	Mild Mixed but majority mild

Subgroup 2: Type of communication difficulty	Aphasia Aphasia but may have also had dyspraxia
Subgroup 3: Total number of hours of therapy delivered using computer tools	21-30 hours
Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	In person delivery
Subgroup 6: Method of therapy	Combinations of the above Word finding and reading
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=17 Usual care only. Concomitant therapy: All people participated in activities that provide general language stimulation as they had done previously including attendance at communication support groups and conversation, reading and writing activities that were a part of everyday life.

Number of participants	34
Duration of follow-up	8 months
Indirectness	No additional information.
Additional comments	Intention to treat analysis.

Study arms

Computer-based tools for speech and language therapy (StepbyStep computer program) (N = 17)
StepbyStep computer program in addition to usual language activities. The program contains a library of >13000 language exercises. Photographic images can be added to enable practice of personally relevant words such as names of people and pets. Each exercise follows steps progressing from listening to target words, producing words with visual, semantic, phonemic or written letter/word cues through to saying the words in sentences. This was configured by a speech and language therapist and supported by a volunteer. Volunteers contacted the person once a week in the first month and at least once a month thereafter by telephone or home visit. Independent practice was advised for at least 20 minutes, 3 days a week for 5 months (approximately 1500 minutes of practice time in total). Concomitant therapy: All people participated in activities that provide general language stimulation as they had done previously including attendance at communication support groups and conversation, reading and writing activities that were a part of everyday life.

Speech and language therapy without computer-based tools (usual care) (N = 17)
Usual care only. Concomitant therapy: All people participated in activities that provide general language stimulation as they had done previously including attendance at communication support groups and conversation, reading and writing activities that were a part of everyday life.

1 **Characteristics**

2 ***Arm-level characteristics***

Characteristic	Computer-based tools for speech and language therapy (StepbyStep computer program) (N = 17)	Speech and language therapy without computer-based tools (usual care) (N = 17)
% Female Sample size	n = 7 ; % = 43.8	n = 5 ; % = 29.4
Mean age (SD) (years) Mean (SD)	69.5 (12.2)	66.2 (12.3)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NA ; % = NA	n = NA ; % = NA
Mild Sample size	n = 9 ; % = 56.3	n = 11 ; % = 64.7
Moderate Sample size	n = 5 ; % = 31.3	n = 4 ; % = 23.5
Severe Sample size	n = 2 ; % = 12.5	n = 2 ; % = 11.8

Characteristic	Computer-based tools for speech and language therapy (StepbyStep computer program) (N = 17)	Speech and language therapy without computer-based tools (usual care) (N = 17)
Time after stroke (years) Range	1 to 29	1.8 to 12
Time after stroke (years) Mean (SD)	6.2 (NR)	6.6 (NR)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA
Fluent aphasia Sample size	n = 3 ; % = 19	n = 3 ; % = 18
Non-fluent aphasia Sample size	n = 12 ; % = 75	n = 13 ; % = 76
Global aphasia Sample size	n = 1 ; % = 6	n = 1 ; % = 6
Dyspraxia in addition to aphasia Sample size	n = 3 ; % = 19	n = 3 ; % = 18

Baseline characteristics reported for 16 people in the intervention group.

Outcomes

Study timepoints
- Baseline
- 8 month (≥3 months)

Continuous outcome

Outcome	Computer-based tools for speech and language therapy (StepbyStep computer program), Baseline, N = 16	Computer-based tools for speech and language therapy (StepbyStep computer program), 8 month, N = 13	Speech and language therapy without computer-based tools (usual care), Baseline, N = 17	Speech and language therapy without computer-based tools (usual care), 8 month, N = 11
Communication - impairment specific measures, naming (words named correctly) (mm) Percentage change. Mean (SD)	NR (NR)	12 (67.9)	NR (NR)	11 (56.6)

Communication - impairment specific measures, naming (words named correctly) - Polarity - Higher values are better

Dichotomous outcome

Outcome	Computer-based tools for speech and language therapy (StepbyStep computer program), Baseline, N = 17	Computer-based tools for speech and language therapy (StepbyStep computer program), 8 month, N = 17	Speech and language therapy without computer-based tools (usual care), Baseline, N = 17	Speech and language therapy without computer-based tools (usual care), 8 month, N = 17
Discontinuation Intervention: 1 withdrew before baseline measures, 3 more lost to	n = NA ; % = NA	n = 4 ; % = 24	n = NA ; % = NA	n = 6 ; % = 35

Outcome	Computer-based tools for speech and language therapy (StepbyStep computer program), Baseline, N = 17	Computer-based tools for speech and language therapy (StepbyStep computer program), 8 month, N = 17	Speech and language therapy without computer-based tools (usual care), Baseline, N = 17	Speech and language therapy without computer-based tools (usual care), 8 month, N = 17
follow up by 8 months. Control: 6 lost to follow up by 8 months. No of events				

Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcome-Communication-impairmentspecificmeasures,naming(wordsnamedcorrectly)-MeanSD-Computer-based tools for speech and language therapy (StepbyStep computer program)-Speech and language therapy without computer-based tools (usual care)-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-NoOfEvents-Computer-based tools for speech and language therapy (StepbyStep computer program)-Speech and language therapy without computer-based tools (usual care)-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Spaccavento, 2021

Bibliographic Reference	Spaccavento, S.; Falcone, R.; Cellamare, F.; Picciola, E.; Glueckauf, R. L.; Effects of computer-based therapy versus therapist-mediated therapy in stroke-related aphasia: Pilot non-inferiority study; Journal of Communication Disorders; 2021; vol. 94; 106158

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)

Study location	Italy.
Study setting	Inpatient.
Study dates	No additional information.
Sources of funding	No sponsors. No financial or personal relationships with other people or organisations that could inappropriately influence their work.
Inclusion criteria	Aphasia resulting from unilateral left-hemisphere lesion, absence of premorbid cognitive impairment or mental health disorders, presence of family caregivers.
Exclusion criteria	People with severe visual difficulties, significant hearing impairment, pre-stroke neuropsychological deficits, psychiatric disorders, history of alcohol or drug abuse, head injury and/or tumoral lesions as well as cortical atrophy or leukoencephalopathy.
Recruitment / selection of participants	People admitted to the neurorehabilitation unit of Clinical Scientific Institutes "Maugeri" SPA SB IRCCS.
Intervention(s)	Computer-based tools for speech and language therapy N=13 Computer-based aphasia treatment. Program edited by Erickson. Training including words and sentence comprehension, written naming, word completion, fluency, word and sentence reorganisation tasks. The complexity of each task was progressively increased based on the severity of each person's language deficit. One, 50 minute session for 5 days per week over a period of 8 weeks. Concomitant therapy: No additional information (all people were provided the same amount of therapy).
Subgroup 1: Severity of communication difficulty (as stated by category)	Mixed Moderate to severe

Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	>30 hours
Subgroup 4: Time after stroke at the start of the trial	Subacute (7 days - 6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	In person delivery
Subgroup 6: Method of therapy	Combinations of the above
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=9 Therapist-mediated aphasia treatment. Including the same areas but delivered by a therapist instead of a computer. One, 50 minute session for 5 days per week over a period of 8 weeks. Concomitant therapy: No additional information (all people were provided the same amount of therapy).
Number of participants	22

Duration of follow-up	8 weeks (end of intervention).
Indirectness	No additional information.
Additional comments	No additional information.

Study arms

Computer-based tools for speech and language therapy (N = 13)
Computer-based aphasia treatment. Program edited by Erickson. Training including words and sentence comprehension, written naming, word completion, fluency, word and sentence reorganisation tasks. The complexity of each task was progressively increased based on the severity of each person's language deficit. One, 50 minute session for 5 days per week over a period of 8 weeks. Concomitant therapy: No additional information (all people were provided the same amount of therapy).

Speech and language therapy without computer-based tools (usual care) (N = 9)
Therapist-mediated aphasia treatment. Including the same areas but delivered by a therapist instead of a computer. One, 50 minute session for 5 days per week over a period of 8 weeks. Concomitant therapy: No additional information (all people were provided the same amount of therapy).

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (N = 13)	Speech and language therapy without computer-based tools (usual care) (N = 9)
% Female Sample size	n = 2 ; % = 15	n = 4 ; % = 44

Characteristic	Computer-based tools for speech and language therapy (N = 13)	Speech and language therapy without computer-based tools (usual care) (N = 9)
Mean age (SD) (years) Mean (SD)	57.38 (9.23)	64.11 (15.04)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NA ; % = NA	n = NA ; % = NA
Moderate aphasia Sample size	n = 4 ; % = 44.5	n = 6 ; % = 46.2
Severe aphasia Sample size	n = 7 ; % = 53.8	n = 5 ; % = 55.5
Time after stroke (days) Mean (SD)	16.54 (11.34)	17.55 (8.51)
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA
Global aphasia	n = 5 ; % = 38.4	n = 4 ; % = 44.4

Characteristic	Computer-based tools for speech and language therapy (N = 13)	Speech and language therapy without computer-based tools (usual care) (N = 9)
Sample size		
Broca aphasia Sample size	n = 3 ; % = 23.1	n = 5 ; % = 55.6
Wernicke's aphasia Sample size	n = 1 ; % = 7.7	n = 0 ; % = 0
Transcortical sensory aphasia Sample size	n = 2 ; % = 15.4	n = 0 ; % = 0
Anomic aphasia Sample size	n = 2 ; % = 15.4	n = 0 ; % = 0

Outcomes

Study timepoints

- Baseline
- 8 week (<3 months)

1 ***Continuous outcomes***

Outcome	Computer-based tools for speech and language therapy, Baseline, N = 13	Computer-based tools for speech and language therapy, 8 week, N = 13	Speech and language therapy without computer-based tools (usual care), Baseline, N = 9	Speech and language therapy without computer-based tools (usual care), 8 week, N = 9
Communication - impairment specific measures, naming (AAT naming subtest score) Scale range: 0-120. Final values. Mean (SD)	29.15 (34.33)	59.46 (51.3)	30.44 (38.92)	74 (39.91)
Communication - impairment specific measures, comprehension (AAT token subtest score) Scale range: 0-50. Final values. Mean (SD)	37.69 (13.41)	26 (19.49)	37.67 (5.29)	24.22 (8.81)
Communication - functional communication (Functional Outcome Questionnaire - Aphasia Total Score) Scale range: 0-128. Final values. Mean (SD)	64 (31.12)	102.16 (51.22)	66.25 (33.02)	115.25 (38.51)
Communication related quality of life (Quality of Life Questionnaire for Aphasics Total Score) Scale range: 0-148. Final values. Mean (SD)	32.83 (29.92)	59.66 (40.49)	38.25 (19.49)	72 (24.45)

Outcome	Computer-based tools for speech and language therapy, Baseline, N = 13	Computer-based tools for speech and language therapy, 8 week, N = 13	Speech and language therapy without computer-based tools (usual care), Baseline, N = 9	Speech and language therapy without computer-based tools (usual care), 8 week, N = 9
Communication - impairment specific measures, expressive language (Functional Assessment Measure Expression) Scale range: 0-7. Final values. Mean (SD)	2.08 (0.64)	3.67 (1.37)	2 (1.12)	3.67 (1.22)
Communication - impairment specific measures, reading (Functional Assessment Measure Reading) Scale range: 0-7. Final values. Mean (SD)	2.46 (1.2)	3.83 (1.7)	2.22 (1.09)	3.78 (1.09)

Communication - impairment specific measures, naming (AAT naming subtest score) - Polarity - Higher values are better
Communication - impairment specific measures, comprehension (AAT token subtest score) - Polarity - Higher values are better
Communication - functional communication (Functional Outcome Questionnaire - Aphasia Total Score) - Polarity - Higher values are better
Communication related quality of life (Quality of Life Questionnaire for Aphasics Total Score) - Polarity - Higher values are better
Communication - impairment specific measures, expressive language (Functional Assessment Measure Expression) - Polarity - Higher values are better
Communication - impairment specific measures, reading (Functional Assessment Measure Reading) - Polarity - Higher values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-impairmentspecificmeasures,naming(AATnamingsubtestscore)-MeanSD-Computer-based tools for speech and language therapy-Speech and language therapy without computer-based tools (usual care)-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,comprehension(AATtokensubtestscore)-MeanSD-Computer-based tools for speech and language therapy-Speech and language therapy without computer-based tools (usual care)-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-functionalcommunication(FunctionalOutcomeQuestionnaire-AphasiaTotalScore)-MeanSD-Computer-based tools for speech and language therapy-Speech and language therapy without computer-based tools (usual care)-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communicationrelatedqualityoflife(QualityofLifeQuestionnaireforAphasicsTotalScore)-MeanSD-Computer-based tools for speech and language therapy-Speech and language therapy without computer-based tools (usual care)-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,expressivelanguage(FunctionalAssessmentMeasureExpression)-MeanSD-Computer-based tools for speech and language therapy-Speech and language therapy without computer-based tools (usual care)-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,reading(FunctionalAssessmentMeasureReading)-MeanSD-Computer-based tools for speech and language therapy-Speech and language therapy without computer-based tools (usual care)-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Low
Overall bias and Directness	Overall Directness	Directly applicable

Varley, 2016

Bibliographic Reference	Varley, R.; Cowell, P. E.; Dyson, L.; Inglis, L.; Roper, A.; Whiteside, S. P.; Self-Administered Computer Therapy for Apraxia of Speech: Two-Period Randomized Control Trial With Crossover; Stroke; 2016; vol. 47 (no. 3); 822-8

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)
Study location	United Kingdom.
Study setting	Community speech and language therapy services.
Study dates	No additional information.
Sources of funding	Funded by the Bupa UK Foundation specialist grant programme.
Inclusion criteria	Adults with chronic apraxia of speech (at least 5 months post onset of apraxic stroke); unilateral left hemisphere lesion(s); the absence of neurodegenerative condition; premorbid competence in English; sufficient auditory/visual acuity to interact with a laptop.
Exclusion criteria	Receiving impairment speech and language therapist.

Recruitment / selection of participants	People recruited from community speech and language therapist services across the South Yorkshire region over a 25-month period.
Intervention(s)	Computer-based tools for speech and language therapy (software therapy) N=50 The software included a perceptual stage (spoken word-picture matching, auditory-written word matching, and auditory lexical decision), followed by a production stage. The perceptual component aimed to consolidate form-meaning representations of target vocabulary and facilitate feedforward input to motor representations. The production stage consisted of hierarchical speech activities. First, people observed videos of word production, followed by blocks of trials requiring imagined production. The program then moved to overt word repetition with increasing delays between stimulus and response. Responses were audiorecorded by the software. The final stages involved more autonomous word production. People used trained words in sentence frames, followed by independent word retrieval/picture naming. Therapy was delivered for 6 weeks. This group then had a washout period of 4 weeks, then received the sham intervention for 6 weeks. Regular use of the software was encouraged (once or twice a day for at least 20 minutes). Concomitant therapy: No additional information.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Apraxia of speech
Subgroup 3: Total number of hours of therapy delivered using computer tools	≤10 hours

Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Expressive language/communication
Population subgroups	No additional information.
Comparator	Placebo N=50 Sham therapy using visuospatial sham program. No speech and language component. Therapy was delivered for 6 weeks. This group then had a washout period of 4 weeks, then received the sham intervention for 6 weeks. Regular use of the software was encouraged (once or twice a day for at least 20 minutes). Concomitant therapy: No additional information.
Number of participants	50 (in the trial in total - 25 in each arm during the randomisation process)
Duration of follow-up	6 weeks (for each phase of the trial)
Indirectness	No additional information.
Additional comments	Intention-to-treat analysis.

1

Study arms

Computer-based tools for speech and language therapy (software therapy) (N = 50)

The software included a perceptual stage (spoken word-picture matching, auditory-written word matching, and auditory lexical decision), followed by a production stage. The perceptual component aimed to consolidate form-meaning representations of target vocabulary and facilitate feedforward input to motor representations. The production stage consisted of hierarchical speech activities. First, people observed videos of word production, followed by blocks of trials requiring imagined production. The program then moved to overt word repetition with increasing delays between stimulus and response. Responses were audiorecorded by the software. The final stages involved more autonomous word production. People used trained words in sentence frames, followed by independent word retrieval/picture naming. Therapy was delivered for 6 weeks. This group then had a washout period of 4 weeks, then received the sham intervention for 6 weeks. Regular use of the software was encouraged (once or twice a day for at least 20 minutes). Concomitant therapy: No additional information.

Placebo (N = 50)

Sham therapy using visuospatial sham program. No speech and language component. Therapy was delivered for 6 weeks. This group then had a washout period of 4 weeks, then received the sham intervention for 6 weeks. Regular use of the software was encouraged (once or twice a day for at least 20 minutes). Concomitant therapy: No additional information.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (software therapy) (N = 50)	Placebo (N = 50)
% Female Sample size	n = 8 ; % = 32	n = 13 ; % = 52
Mean age (SD) (years) Range	28 to 91	36 to 86

Characteristic	Computer-based tools for speech and language therapy (software therapy) (N = 50)	Placebo (N = 50)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Range	NA to NA	NA to NA
Aphasia severity Range	8 to 40	6 to 40
Apraxia of speech severity Range	0 to 11	0 to 9
Time after stroke (Months) Range	5 to 54	5 to 105
Type of communication difficulty Sample size	n = NA ; % = NA	n = NA ; % = NA

Arms reported have 25 participants in each rather than 50 for the purposes of this table.

Outcomes

Study timepoints

- Baseline

- 6 week (<3 months)

Continuous outcome

Outcome	Computer-based tools for speech and language therapy (software therapy), Baseline, N = 50	Computer-based tools for speech and language therapy (software therapy), 6 week, N = 50	Placebo, Baseline, N = 50	Placebo, 6 week, N = 50
Communication - impairment specific measures, naming (Naming Accuracy Combination of the treated groups from the sham-first and speech-first groups and the control groups for both arms. Scale range unclear. Final values. Mean (SD)	13.21 (8.45)	15.79 (8.14)	13.08 (8.58)	13.99 (8.75)

Communication - impairment specific measures, naming (Naming Accuracy - Polarity - Higher values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Cross-over trial

Continuousoutcome-Communication-impairmentspecificmeasures,naming(NamingAccuracy-MeanSD-Computer-based tools for speech and language therapy (software therapy)-Placebo-t6

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Some concerns
Overall bias and Directness	Overall Directness	Directly applicable

1 **Woolf, 2016**

Bibliographic Reference	Woolf, C.; Caute, A.; Haigh, Z.; Galliers, J.; Wilson, S.; Kessie, A.; Hirani, S.; Hegarty, B.; Marshall, J.; A comparison of remote therapy, face to face therapy and an attention control intervention for people with aphasia: a quasi-randomised controlled feasibility study; Clinical Rehabilitation; 2016; vol. 30 (no. 4); 359-73

2

3 **Study details**

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Quasi- randomised controlled trial
Study location	United Kingdom.
Study setting	A University lab and NHS outpatient service.
Study dates	March 2013 and November 2013.
Sources of funding	This work was supported by the Tavistock Trust for Aphasia, the Charles Wolfson Charitable Trust and the Bupa Foundation (grant number: TBF-PPW 11-017F).
Inclusion criteria	People of at least 6 months post a left hemisphere stroke; word finding difficulties due to aphasia (scoring between 20% and 70% correct on the spoken picture naming subtest of the Comprehensive Aphasia Test; demonstrated picture recognition and memory skills (scoring at least 70% on the CAT semantic and recognition memory subtests). People also

	had to nominate a family member, friend or volunteer who could act as their partner in a conversation assessment and, if relevant, support their use of technology. Partners had no neurological impairment and no significant hearing loss.
Exclusion criteria	Signs of visual neglect (scoring within normal limits on the CAT line bisection test); hearing loss greater than 40dB (established via pure tone audiometry); had secondary neurological diagnosis such as dementia; receiving speech and language therapy elsewhere.
Recruitment / selection of participants	People were recruited from community stroke groups in London, from the membership of a University aphasia research clinic, via an inner London NHS rehabilitation service and through self/relative referrals (e.g. from individuals who read about the project on line).
Intervention(s)	Computer-based tools for speech and language therapy (telerehabilitation) N=10 Eight sessions of word finding therapy, delivered remotely. The remote conditions used mainsteam video conferencing technology. This is the combination of two groups, remote therapy from university (n=5) and remote therapy from clinical site (n=5). The interventions delivered included semantic verification and picture naming. Remote therapy was administered via FaceTime using iPads. Therapy was delivered twice a week for four weeks. Concomitant therapy: All people were provided with a workbook, comprising pictures of their target words. Each person worked on 50 words, with each word targeted at least once per session.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered using computer tools	≤10 hours

Subgroup 4: Time after stroke at the start of the trial	Chronic (>6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Word finding therapy
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=5 Face-to-face sessions of word finding therapy. The same procedure as the computer-based tools group but delivered face to face. Concomitant therapy: All people were provided with a workbook, comprising pictures of their target words. Each person worked on 50 words, with each word targeted at least once per session. Social support/stimulation N=5 Attention control condition where 8 remote conversation sessions were received. These were delivered over the internet using FaceTime. Sessions were scheduled twice a week (8 hours in total). The conversations were conducted with students of speech and language therapy.

	Concomitant therapy: No additional information (did not receive the concomitant therapy available to the other groups).
Number of participants	20
Duration of follow-up	4 weeks (end of intervention).
Indirectness	No additional information.
Additional comments	ITT last value carried forward.

Study arms

Computer-based tools for speech and language therapy (telerehabilitation) (N = 10)
Eight sessions of word finding therapy, delivered remotely. The remote conditions used mainsteam video conferencing technology. This is the combination of two groups, remote therapy from university (n=5) and remote therapy from clinical site (n=5). The interventions delivered included semantic verification and picture naming. Remote therapy was administered via FaceTime using iPads. Therapy was delivered twice a week for four weeks. Concomitant therapy: All people were provided with a workbook, comprising pictures of their target words. Each person worked on 50 words, with each word targeted at least once per session.

Speech and language therapy without computer-based tools (usual care) (N = 5)
Face-to-face sessions of word finding therapy. The same procedure as the computer-based tools group but delivered face to face. Concomitant therapy: All people were provided with a workbook, comprising pictures of their target words. Each person worked on 50 words, with each word targeted at least once per session.

Social support/stimulation (N = 5)
Attention control condition where 8 remote conversation sessions were received. These were delivered over the internet using FaceTime. Sessions were scheduled twice a week (8 hours in total). The conversations were conducted with students of speech and language therapy. Concomitant therapy: No additional information (did not receive the concomitant therapy available to the other groups).

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 10)	Speech and language therapy without computer-based tools (usual care) (N = 5)	Social support/stimulation (N = 5)
% Female Sample size	n = 3 ; % = 30	n = 2 ; % = 40	n = 1 ; % = 20
Mean age (SD) (years) Mean (SD)	62.9 (12.1)	57.8 (14.38)	53 (13.93)
Ethnicity Sample size	n = NR ; % = NR	n = NR ; % = NR	n = NR ; % = NR
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (Months) Mean (SD)	42.6 (25.1)	35.2 (*empty data*)	20.2 (10.64)
Type of communication difficulty	n = NR ; % = NR	n = NR ; % = NR	n = NR ; % = NR

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 10)	Speech and language therapy without computer-based tools (usual care) (N = 5)	Social support/stimulation (N = 5)
All people had aphasia, type not stated. Sample size			

Outcomes

Study timepoints

- Baseline
- 8 week (<3 months)
- 14 week (≥3 months)

1 ***Continuous outcome***

Outcome	Computer-based tools for speech and language therapy (telerehabilitation), Baseline, N = 10	Computer-based tools for speech and language therapy (telerehabilitation), 8 week, N = 10	Computer-based tools for speech and language therapy (telerehabilitation), 14 week, N = 10	Speech and language therapy without computer-based tools (usual care), Baseline, N = 5	Speech and language therapy without computer-based tools (usual care), 8 week, N = 5	Speech and language therapy without computer-based tools (usual care), 14 week, N = 4	Social support/stimulation, Baseline, N = 5	Social support/stimulation, 8 week, N = 5	Social support/stimulation, 14 week, N = 5
Communication - impairment specific measures, naming (Naming assessment) Scale range: unclear, possibly 0-100. Final values. Based on the number of items that	6.2 (5.45)	38.6 (18.72)	38.3 (18.76)	3.6 (5.5)	38 (16.4)	39.4 (17.88)	4.8 (10.73)	9.6 (10.14)	9.8 (12.28)

Outcome	Computer-based tools for speech and language therapy (telerehabilitation), Baseline, N = 10	Computer-based tools for speech and language therapy (telerehabilitation), 8 week, N = 10	Computer-based tools for speech and language therapy (telerehabilitation), 14 week, N = 10	Speech and language therapy without computer-based tools (usual care), Baseline, N = 5	Speech and language therapy without computer-based tools (usual care), 8 week, N = 5	Speech and language therapy without computer-based tools (usual care), 14 week, N = 4	Social support/stimulation, Baseline, N = 5	Social support/stimulation, 8 week, N = 5	Social support/stimulation, 14 week, N = 5
can be named out of 100. Values taken from the total score (rather than treated or untreated words). Mean (SD)									

1 Communication - impairment specific measures, naming (Naming assessment) - Polarity - Higher values are better

1 ***Dichotomous outcome***

Outcome	Computer-based tools for speech and language therapy (telerehabilitation), Baseline, N = 10	Computer-based tools for speech and language therapy (telerehabilitation), 8 week, N = 10	Computer-based tools for speech and language therapy (telerehabilitation), 14 week, N = 10	Speech and language therapy without computer-based tools (usual care), Baseline, N = 5	Speech and language therapy without computer-based tools (usual care), 8 week, N = 5	Speech and language therapy without computer-based tools (usual care), 14 week, N = 5	Social support/stimulation, Baseline, N = 5	Social support/stimulation, 8 week, N = 5	Social support/stimulation, 14 week, N = 5
Discontinuation 1 not available at 14 week assessment from the speech and language therapy without computer-based tools arm No of events	n = 0 ; % = 0	n = 0 ; % = 0	n = 0 ; % = 0	n = 0 ; % = 0	n = 0 ; % = 0	n = 1 ; % = 20	n = 0 ; % = 0	n = 0 ; % = 0	n = 0 ; % = 0

2 Discontinuation - Polarity - Lower values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcome-Communication-impairmentspecificmeasures,naming(Namingassessment)-Computerbasedtoolscomparedtowithoutcomputerbasedtools-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-Social support/stimulation-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcome-Communication-impairmentspecificmeasures,naming(Namingassessment)-Computerbasedtoolscomparedtowithoutcomputerbasedtools-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-Social support/stimulation-t14

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcome-Communication-impairmentspecificmeasures,naming(Namingassessment)-Computerbasedtoolscomparedtosocialsupport/stimulation-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-Social support/stimulation-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High

Section	Question	Answer
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcome-Communication-impairmentspecificmeasures,naming(Namingassessment)-Computerbasedtoolscomparedtosocialsupport/stimulation-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-Social support/stimulation-t14

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-Computerbasedtoolscomparedtowithoutcomputerbasedtools-NoOfEvents-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-Social support/stimulation-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-Computerbasedtoolscomparedtowithoutcomputerbasedtools-NoOfEvents-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-Social support/stimulation-t14

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-Computerbasedtoolscomparedtosocialsupport/stimulation-NoOfEvents-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-Social support/stimulation-t8

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Dichotomousoutcome-Discontinuation-Computerbasedtoolscomparedtosocialsupport/stimulation-NoOfEvents-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-Social support/stimulation-t14

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Zhou, 2018

Bibliographic Reference	Zhou, Q.; Lu, X.; Zhang, Y.; Sun, Z.; Li, J.; Zhu, Z.; Telerehabilitation Combined Speech-Language and Cognitive Training Effectively Promoted Recovery in Aphasia Patients; Frontiers in Psychology; 2018; vol. 9; 2312

Study details

Secondary publication of another included study- see primary study for details	No additional information.
Other publications associated with this study included in review	No additional information.
Trial name / registration number	No additional information.
Study type	Randomised controlled trial (RCT)
Study location	Italy
Study setting	Inpatients and outpatients
Study dates	No additional information.
Sources of funding	This work was supported by grants from the Natural Science Foundation of China (NSFC 31571156, 31871133) and grants from Jiangsu Province (BRA2017392, 2017-JY-025, H201670 and KYLX16_1302).
Inclusion criteria	No abnormality in language function before onset; people were diagnosed with cerebral infarction or cerebral haemorrhage; lesions were stable; people were able to perform training tasks; no obvious memory impairment or intelligence impairment.

Exclusion criteria	Exacerbation, new infarctions or bleeding lesions; hearing impairments; visual disturbance; severe mental illness; intellectual disturbance; could not tolerate the assessment tasks or treatment; had epilepsy or disturbance of consciousness.
Recruitment / selection of participants	People with aphasia recruited from Jiangsu Provincial People's Hospital rehabilitation medicine center.
Intervention(s)	Computer-based tools for speech and language therapy (telerehabilitation) N=20 Telerehabilitation training program adopted from the Wispirit Inc. The program included both a speech-language module and a cognitive training module. The speech-language module included tasks on auditory comprehension, reading comprehension, repetition, naming and writing. The cognitive module included tasks about attention, memory and executive function. On each training day, the person completed five cognitive rehabilitation games (2 minutes per day) and four speech rehabilitation games (5 minutes per day). Training was 30 minutes a session, 2 times a day for 30 days. The inpatient group received just computerized speech and language therapy while the outpatient group received computerized speech-language therapy for 30 minutes a day in addition to 30 minutes a day of family topics communication for 30 minutes a day. Concomitant therapy: No additional information.
Subgroup 1: Severity of communication difficulty (as stated by category)	Not stated/unclear
Subgroup 2: Type of communication difficulty	Aphasia
Subgroup 3: Total number of hours of therapy delivered	21-30 hours

using computer tools	
Subgroup 4: Time after stroke at the start of the trial	Subacute (7 days - 6 months)
Subgroup 5: Remote delivery compared to in person delivery of sessions	Remote delivery
Subgroup 6: Method of therapy	Combinations of the above
Population subgroups	No additional information.
Comparator	Speech and language therapy without computer-based tools (usual care) N=20 The inpatient group received routine therapy twice a day for 30 minutes a session. The outpatient group received family topics communication for 30 minutes a session, 2 times a day for 30 days. Concomitant therapy: No additional information.
Number of participants	40
Duration of follow-up	Presumed 1 month (end of intervention). Inpatients may not have received therapy for that entire time though and it is unclear from the study how long they received treatment for.
Indirectness	No additional information.
Additional comments	No additional information.

1

Study arms

Computer-based tools for speech and language therapy (telerehabilitation) (N = 20)

Telerehabilitation training program adopted from the Wispirit Inc. The program included both a speech-language module and a cognitive training module. The speech-language module included tasks on auditory comprehension, reading comprehension, repetition, naming and writing. The cognitive module included tasks about attention, memory and executive function. On each training day, the person completed five cognitive rehabilitation games (2 minutes per day) and four speech rehabilitation games (5 minutes per day). Training was 30 minutes a session, 2 times a day for 30 days. The inpatient group received just computerized speech and language therapy while the outpatient group received computerized speech-language therapy for 30 minutes a day in addition to 30 minutes a day of family topics communication for 30 minutes a day. Concomitant therapy: No additional information.

Speech and language therapy without computer-based tools (usual care) (N = 20)

The inpatient group received routine therapy twice a day for 30 minutes a session. The outpatient group received family topics communication for 30 minutes a session, 2 times a day for 30 days. Concomitant therapy: No additional information.

Characteristics

Arm-level characteristics

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 20)	Speech and language therapy without computer-based tools (usual care) (N = 20)
% Female Sample size	n = 10 ; % = 50	n = 11 ; % = 55
Mean age (SD) (years) Mean (SD)	59.2 (11.4)	56.3 (15.9)
Ethnicity	n = NR ; % = NR	n = NR ; % = NR

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 20)	Speech and language therapy without computer-based tools (usual care) (N = 20)
Sample size		
Comorbidities Sample size	n = NR ; % = NR	n = NR ; % = NR
Severity Sample size	n = NR ; % = NR	n = NR ; % = NR
Time after stroke (days) Mean (SD)	32.9 (19.04)	31.35 (19.86)
Type of communication difficulty Sample size	n = NR ; % = NR	n = NR ; % = NR
Basal ganglia aphasia Sample size	n = 3 ; % = 15	n = 1 ; % = 5
Thalamic aphasia Sample size	n = 0 ; % = 0	n = 1 ; % = 5
Global aphasia Sample size	n = 9 ; % = 45	n = 9 ; % = 45
Broca aphasia Sample size	n = 5 ; % = 25	n = 3 ; % = 15

Characteristic	Computer-based tools for speech and language therapy (telerehabilitation) (N = 20)	Speech and language therapy without computer-based tools (usual care) (N = 20)
Wernicke aphasia Sample size	n = 1 ; % = 5	n = 0 ; % = 0
Anomic aphasia Sample size	n = 1 ; % = 5	n = 3 ; % = 15
Mixed transcortical aphasia Sample size	n = 1 ; % = 5	n = 2 ; % = 10
Transcortical motor aphasia Sample size	n = 0 ; % = 0	n = 1 ; % = 5

Outcomes

Study timepoints

- Baseline
- 1 month (<3 months)

1 ***Continuous outcomes***

Outcome	Computer-based tools for speech and language therapy (telerehabilitation), Baseline, N = 20	Computer-based tools for speech and language therapy (telerehabilitation), 1 month, N = 20	Speech and language therapy without computer-based tools (usual care), Baseline, N = 20	Speech and language therapy without computer-based tools (usual care), 1 month, N = 20
Communication - Overall language ability (Aphasic quotient) Scale range: 0-100. Final values. Mean (SD)	33.6 (26.1)	56.7 (21.7)	41.9 (29.1)	52.5 (27.4)
Communication - impairment specific measures, naming (WAB naming) Scale range: Unclear. Final values. Mean (SD)	3.2 (2.9)	5.4 (2.4)	3.6 (3)	4.4 (2.8)
Communication - impairment specific measures, auditory comprehension (WAB auditory comprehension) Scale range: Unclear. Final values. Mean (SD)	4.2 (2.6)	6.5 (2)	5.2 (3.1)	6.1 (2.8)
Communication - Functional communication (Communication activities of daily living)	18.5 (21)	34.9 (22.6)	24.75 (24.2)	32.2 (25.5)

Outcome	Computer-based tools for speech and language therapy (telerehabilitation), Baseline, N = 20	Computer-based tools for speech and language therapy (telerehabilitation), 1 month, N = 20	Speech and language therapy without computer-based tools (usual care), Baseline, N = 20	Speech and language therapy without computer-based tools (usual care), 1 month, N = 20
Scale range: Unclear. Final values. Mean (SD)				

Communication - Overall language ability (Aphasic quotient) - Polarity - Higher values are better
Communication - impairment specific measures, naming (WAB naming) - Polarity - Higher values are better
Communication - impairment specific measures, auditory comprehension (WAB auditory comprehension) - Polarity - Higher values are better
Communication - Functional communication (Communication activities of daily living) - Polarity - Higher values are better

Critical appraisal - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Continuousoutcomes-Communication-Overalllanguageability(Aphasicquotient)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t1

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,naming(WABnaming)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t1

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-impairmentspecificmeasures,auditorycomprehension(WABauditorycomprehension)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t1

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Continuousoutcomes-Communication-Functionalcommunication(Communicationactivitiesofdailyliving)-MeanSD-Computer-based tools for speech and language therapy (telerehabilitation)-Speech and language therapy without computer-based tools (usual care)-t1

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High
Overall bias and Directness	Overall Directness	Directly applicable

Appendix E – Forest plots

E.1 Computer-based tools for speech and language therapy compared to speech and language therapy without computer-based tools (usual care)

Figure 2: Person/participant generic health-related quality of life (EuroQol-5D, 0-100, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI	IV, Fixed, 95% CI
Maresca 2019	22	2.7552318	15	8.7	7.552318	15	13.30 [9.23, 17.37]	

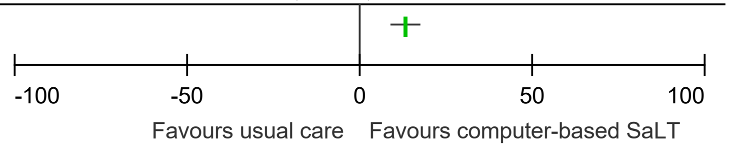


Figure 3: Person/participant generic health-related quality of life (EQ-5D-5L, -0.11-1, higher values are better, final value) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI	IV, Fixed, 95% CI
Palmer 2019	0.59	0.25	97	0.65	0.23	101	-0.06 [-0.13, 0.01]	

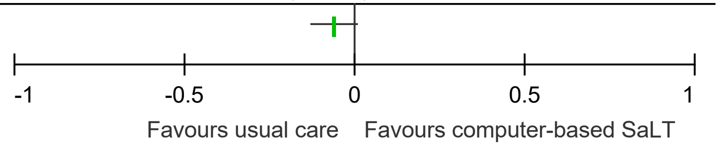


Figure 4: Communication - overall language ability (Western Aphasia Battery Aphasia Quotient, 0-100, higher values are better, change score and final values) at <3 months

	Computer-based SaLT			Usual care				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Kesav 2017	63.5	33.8	11	65.1	27.6	9	2.3%	-1.60 [-28.51, 25.31]
Liu 2021	18.08	8.43	33	5.2	9.79	35	90.4%	12.88 [8.55, 17.21]
Zhou 2018	56.7	21.7	20	52.5	27.4	20	7.2%	4.20 [-11.12, 19.52]
Total (95% CI)			**64**			**64**	**100.0%**	**11.91 [7.79, 16.03]**

Heterogeneity: Chi² = 2.13, df = 2 (P = 0.34); I² = 6%

Test for overall effect: Z = 5.66 (P < 0.00001)

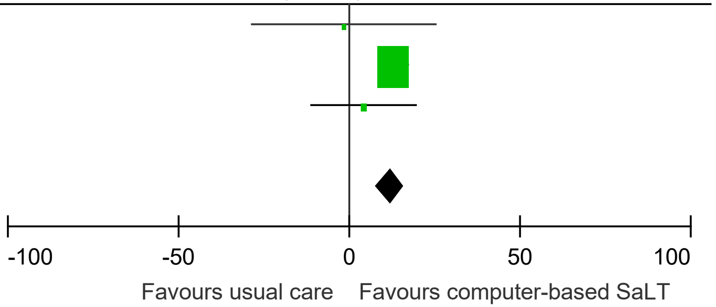


Figure 5: Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change scores and final value) at ≥3 months

	Computer-based SaLT			Usual care				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Braley 2021	6.75	6.16	17	0.38	5.47	15	49.9%	6.37 [2.34, 10.40]
Cherney 2010	3.29	6.16	11	-0.4	3.44	14	49.1%	3.69 [-0.37, 7.75]
Kesav 2017	67.6	32.7	11	73.3	32.7	9	1.0%	-5.70 [-34.51, 23.11]
Total (95% CI)			**39**			**38**	**100.0%**	**4.94 [2.09, 7.78]**

Heterogeneity: Chi² = 1.37, df = 2 (P = 0.50); I² = 0%

Test for overall effect: Z = 3.40 (P = 0.0007)

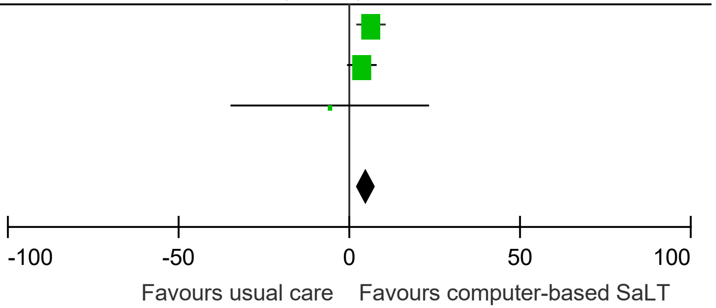


Figure 6: Communication - overall language ability (Aphasia severity rating scale, 0-5, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	2.48	0.77	25	2.44	0.92	25	0.04 [-0.43, 0.51]

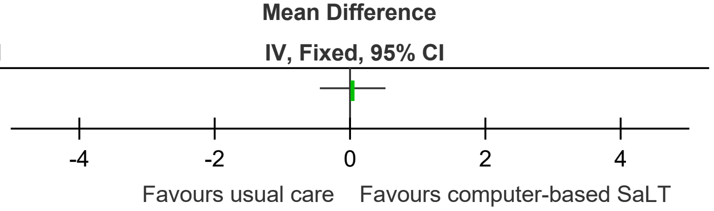


Figure 7: Communication - impairment specific measures (naming) (Western Aphasia Battery oral naming, scale range unclear, higher values are better, change score) at <3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Liu 2021	1.26	2.92	33	0.37	2.44	35	0.89 [-0.39, 2.17]

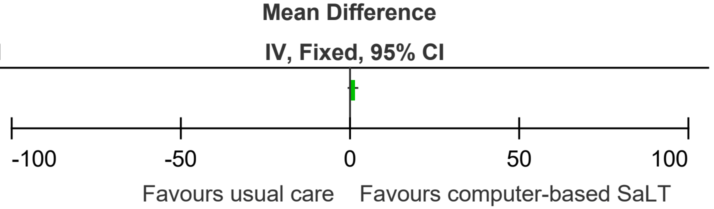


Figure 8: Communication - impairment specific measures (naming) (Western Aphasia Battery naming and word finding subscale, NGA subscale naming, AAT naming subtest, naming assessment [different scale ranges], higher values are better, final values) at <3 months

	Computer-based SaLT			Usual care				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Meltzer 2018	51	28	22	66	31	22	23.9%	-0.50 [-1.10, 0.10]
Ora 2020	47.3	18.9	32	50.2	23.3	30	34.7%	-0.14 [-0.63, 0.36]
Spaccavento 2021	59.46	51.3	13	74	39.91	9	11.8%	-0.30 [-1.15, 0.56]
Woolf 2016	38.6	18.72	10	38	16.4	5	7.5%	0.03 [-1.04, 1.10]
Zhou 2018	5.4	2.4	20	4.4	2.8	20	22.1%	0.38 [-0.25, 1.00]
Total (95% CI)			**97**			**86**	**100.0%**	**-0.12 [-0.41, 0.18]**

Heterogeneity: Chi² = 4.18, df = 4 (P = 0.38); I² = 4%
Test for overall effect: Z = 0.77 (P = 0.44)

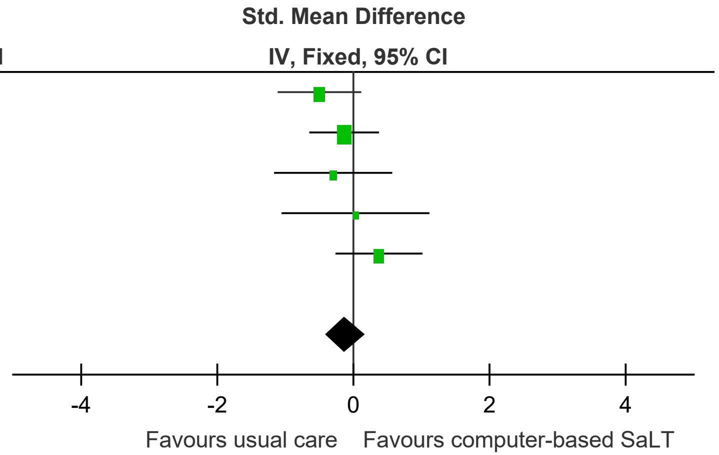


Figure 9: Communication - impairment specific measures (naming) (Boston Naming Test, items, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	47.04	11.06	25	37.08	11.33	25	9.96 [3.75, 16.17]

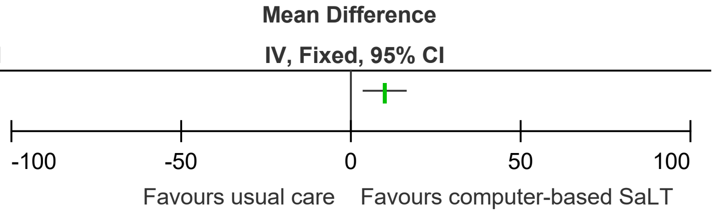


Figure 10: Communication - impairment specific measures (naming) (words named correctly, word finding ability, %, higher values are better, change scores) at ≥3 months

	Computer-based SaLT			Usual care				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Palmer 2012	12	67.9	13	11	56.6	11	0.9%	1.00 [-48.81, 50.81]
Palmer 2019	16.1	16.6	94	5.2	16	97	99.1%	10.90 [6.27, 15.53]
Total (95% CI)			**107**			**108**	**100.0%**	**10.82 [6.21, 15.42]**

Heterogeneity: Chi² = 0.15, df = 1 (P = 0.70); I² = 0%
Test for overall effect: Z = 4.60 (P < 0.00001)

Figure 11: Communication - impairment specific measures (naming) (NGA subtest naming, Naming Assessment, 0-100, higher values are better, final values) at ≥3 months

	Computer-based SaLT			Usual care				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Ora 2020	50.4	22.4	32	54.1	24.9	30	76.0%	-3.70 [-15.52, 8.12]
Woolf 2016	38.3	18.76	10	39.4	17.88	4	24.0%	-1.10 [-22.13, 19.93]
Total (95% CI)			**42**			**34**	**100.0%**	**-3.08 [-13.38, 7.23]**

Heterogeneity: Chi² = 0.04, df = 1 (P = 0.83); I² = 0%

Test for overall effect: Z = 0.59 (P = 0.56)

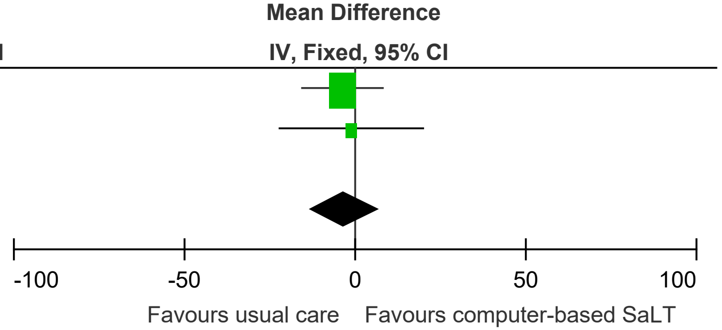


Figure 12: Communication - impairment specific measures (auditory comprehension) (Western Aphasia Battery auditory comprehension, scale range unclear, higher values are better, change score) at <3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Liu 2021	2.31	1.26	33	2.44	0.93	35	-0.13 [-0.66, 0.40]

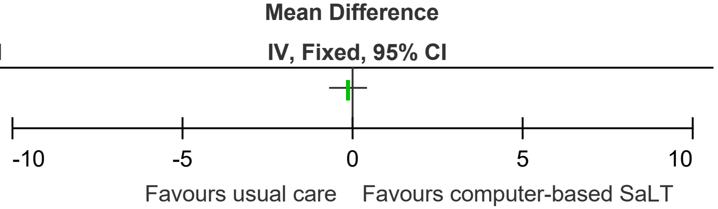


Figure 13: Communication - impairment specific measures (auditory comprehension) (Western Aphasia Battery comprehension subtest, NGA comprehension subtest, AAT token subtest [different scale ranges], higher values are better, final values) at <3 months

	Computer-based SaLT			Usual care				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Meltzer 2018	138	47	22	153	53	22	26.1%	-0.29 [-0.89, 0.30]
Ora 2020	59.3	23.3	32	59.2	28.5	30	37.2%	0.00 [-0.49, 0.50]
Spaccavento 2021	26	19.49	13	24.22	8.81	9	12.8%	0.11 [-0.74, 0.96]
Zhou 2018	6.5	2	20	6.1	2.8	20	23.9%	0.16 [-0.46, 0.78]
Total (95% CI)			**87**			**81**	**100.0%**	**-0.02 [-0.33, 0.28]**

Heterogeneity: Chi² = 1.24, df = 3 (P = 0.74); I² = 0%
Test for overall effect: Z = 0.15 (P = 0.88)

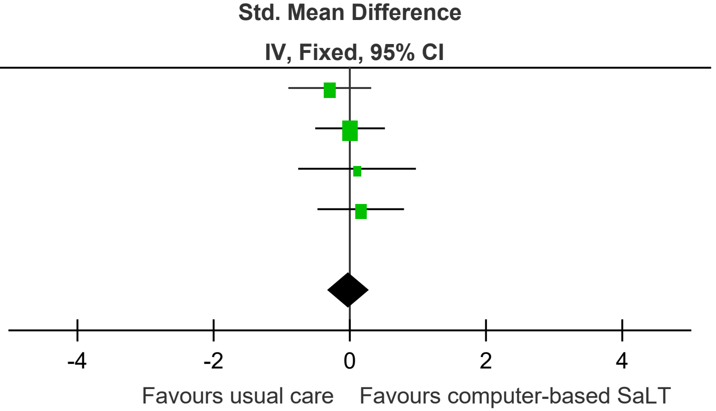


Figure 14: Communication - impairment specific measures (auditory comprehension) (Token test, 0-36, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Maresca 2019	-7.3	2.28506	15	-2	2.28506	15	-5.30 [-6.94, -3.66]

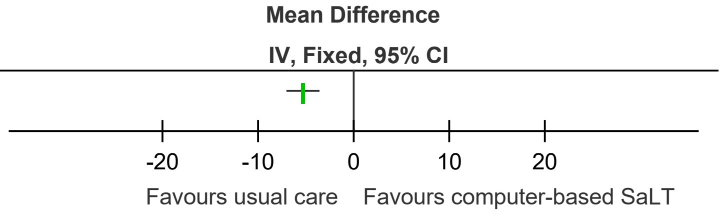


Figure 15: Communication - impairment specific measures (auditory comprehension) (BDAE complex ideational material subtest, 0-10, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	4.6	2.27	25	4.4	2.97	25	0.20 [-1.27, 1.67]

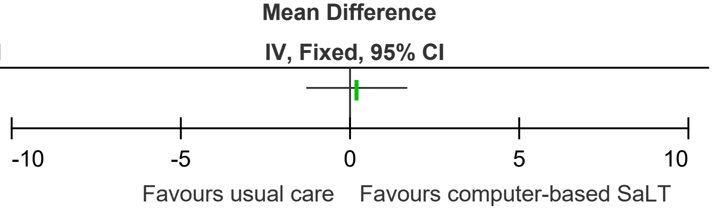


Figure 16: Communication - impairment specific measures (auditory comprehension) (BDAE commands subtest, 0-24, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	4.88	3.68	25	4.8	3.81	25	0.08 [-2.00, 2.16]

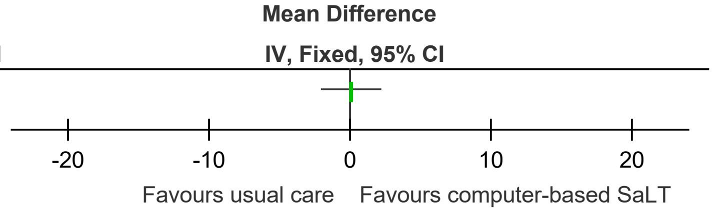


Figure 17: Communication - impairment specific measures (auditory comprehension) (BDAE basic word discrimination subtest, 0-72, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	10.56	9.22	25	10.36	8.53	25	0.20 [-4.72, 5.12]

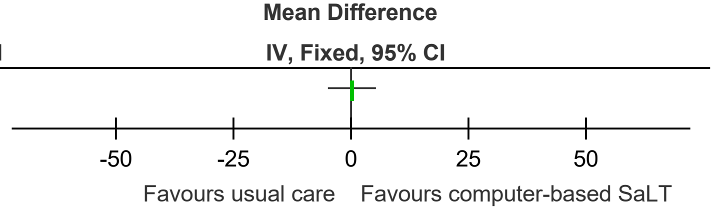


Figure 18: Communication - impairment specific measures (auditory comprehension) (NGA subtest comprehension, 0-100, higher values are better, final value) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Ora 2020	61	24	32	61.5	29.5	30	-0.50 [-13.94, 12.94]

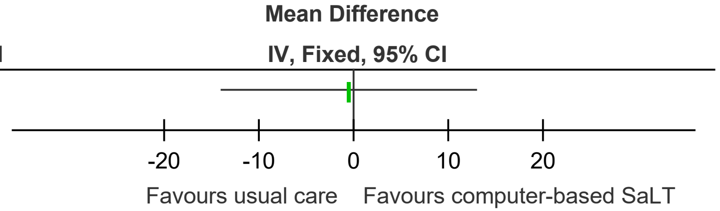


Figure 19: Communication - impairment specific measures (reading) (Functional Assessment Measure Reading, 0-7, higher values are better, final value) at <3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Spaccavento 2021	3.83	1.7	13	3.78	1.09	9	0.05 [-1.12, 1.22]

Mean Difference
IV, Fixed, 95% CI

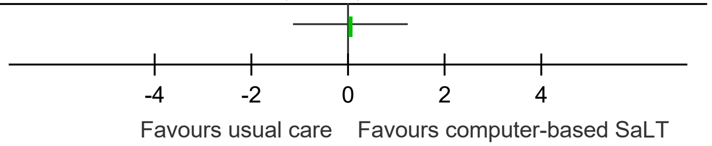


Figure 20: Communication - impairment specific measures (reading) (Western Aphasia Battery reading, 0-100, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Cherney 2010	-3.55	13.16	11	1.36	12.8	14	-4.91 [-15.18, 5.36]

Mean Difference
IV, Fixed, 95% CI

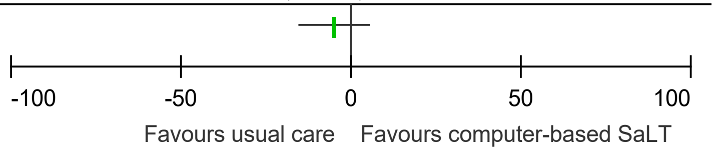


Figure 21: Communication - impairment specific measures (reading) (BDAE basic oral reading subtest, 0-30, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	10.3	5.32	25	10.21	6.24	25	0.09 [-3.12, 3.30]

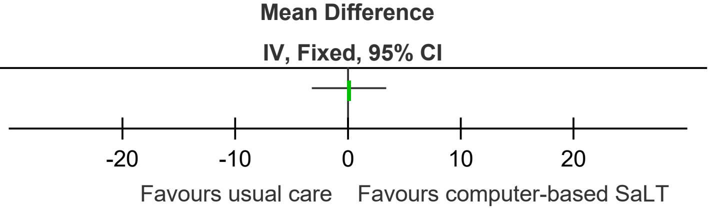


Figure 22: Communication - impairment specific measures (reading) (BDAE oral reading of sentences with comprehension, 0-10, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	4.6	1.73	25	4.53	2.04	25	0.07 [-0.98, 1.12]

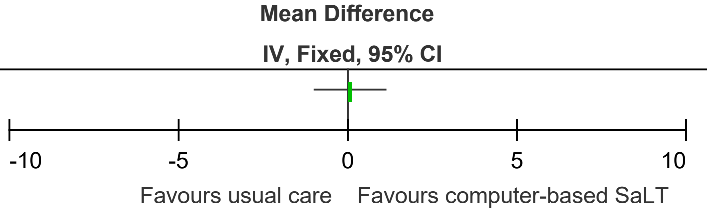


Figure 23: Communication - impairment specific measures (expressive language) (Western Aphasia Battery Spontaneous speech, scale range unclear, higher values are better, change score) at <3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Liu 2021	3.13	3.04	33	1.4	2.1	35	1.73 [0.48, 2.98]

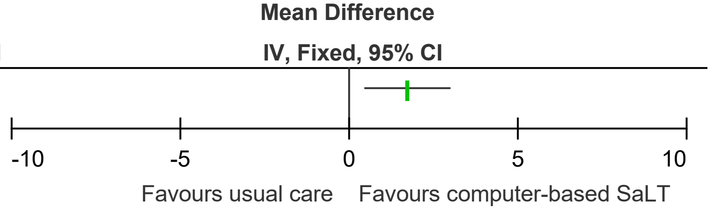


Figure 24: Communication - impairment specific measures (expressive language) (Western Aphasia Battery Spontaneous speech, Functional Assessment Measure Expression, [different scale ranges], higher values are better, final values) at <3 months

	Computer-based SaLT			Usual care				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Meltzer 2018	11.6	6.2	22	12.6	4.4	22	67.3%	-0.18 [-0.77, 0.41]
Spaccavento 2021	3.67	1.37	13	3.67	1.22	9	32.7%	0.00 [-0.85, 0.85]
Total (95% CI)			**35**			**31**	**100.0%**	**-0.12 [-0.61, 0.36]**

Heterogeneity: Chi² = 0.12, df = 1 (P = 0.73); I² = 0%

Test for overall effect: Z = 0.50 (P = 0.62)

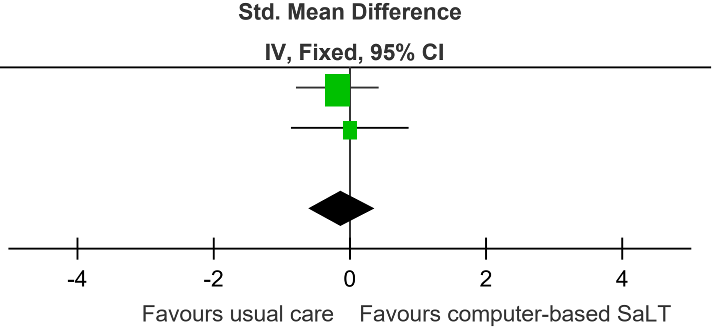


Figure 25: Communication - impairment specific measures (expressive language) (BDAE articulatory agility subtest, 1-7, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	1.24	0.78	25	1.04	1.14	25	0.20 [-0.34, 0.74]

Mean Difference
IV, Fixed, 95% CI

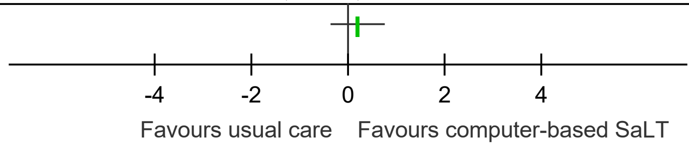


Figure 26: Communication - impairment specific measures (expressive language) (BDAE grammatical forms subtest, 1-7, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	2.88	1.17	25	2.4	1.04	25	0.48 [-0.13, 1.09]

Mean Difference
IV, Fixed, 95% CI

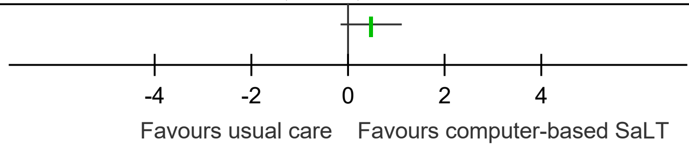


Figure 27: Communication - impairment specific measures (expressive language) (BDAE melodic line subtest, 1-7, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	3.04	1.06	25	2.04	1.06	25	1.00 [0.41, 1.59]

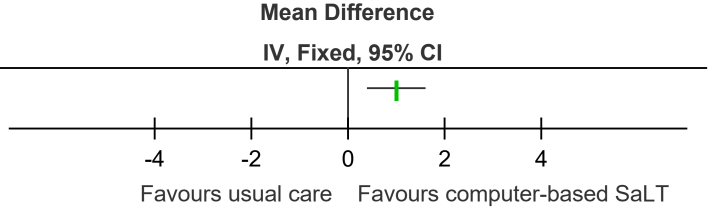


Figure 28: Communication - impairment specific measures (expressive language) (BDAE paraphrasia subtest, 1-7, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	3.92	2.25	25	2.28	2.01	25	1.64 [0.46, 2.82]

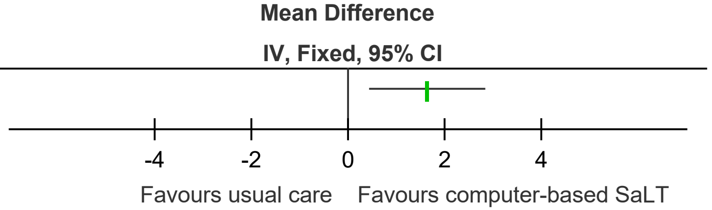


Figure 29: Communication - impairment specific measures (expressive language) (BDAE phrase length subtest, 1-7, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	2.8	1.22	25	2.12	0.73	25	0.68 [0.12, 1.24]

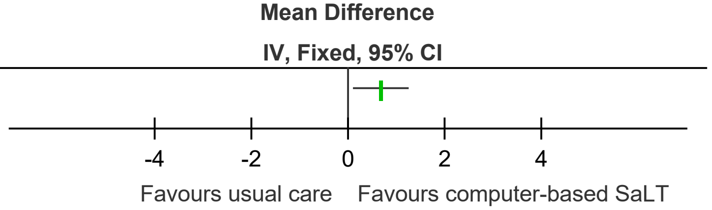


Figure 30: Communication - impairment specific measures (expressive language) (BDAE word-finding relative to fluency subtest, 1-7, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Elhakeem 2021	1.28	1.1	25	0.48	1.73	25	0.80 [-0.00, 1.60]

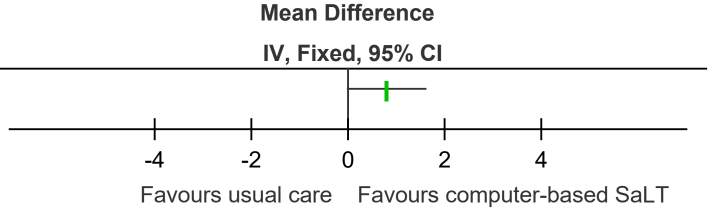


Figure 31: Communication - impairment specific measures (dysarthria - speech impairment) (Frenchay Dysarthria Assessment-II, unclear scale range, higher values are better, final value) at <3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Mitchell 2018	177	38.6	23	184	20.4	14	-7.00 [-26.05, 12.05]

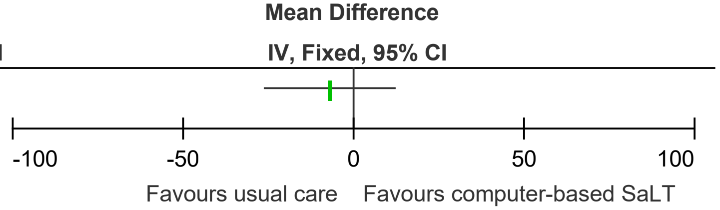


Figure 32: Communication - impairment specific measures (dysarthria - activity) (Dysarthria Therapy Outcome Measures, unclear scale range, higher values are better, final value) at <3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Mitchell 2018	3.6	1.1	23	3.9	0.6	14	-0.30 [-0.85, 0.25]

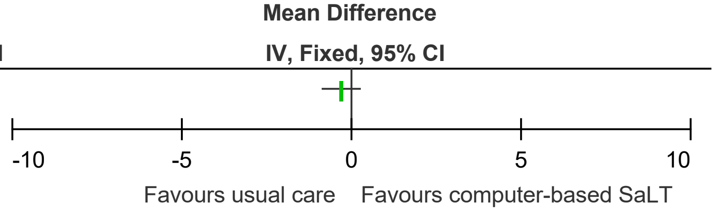


Figure 33: Communication - functional communication (Communication activities of daily living, functional outcome questionnaire aphasia total score [different scale ranges], higher values are better, final values) at <3 months

	Computer-based SaLT			Usual care				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Spaccavento 2021	102.16	51.22	13	115.25	38.51	9	34.5%	-0.27 [-1.12, 0.58]
Zhou 2018	34.9	22.6	20	32.2	25.5	20	65.5%	0.11 [-0.51, 0.73]
Total (95% CI)			**33**			**29**	**100.0%**	**-0.02 [-0.52, 0.48]**

Heterogeneity: Chi² = 0.50, df = 1 (P = 0.48); I² = 0%

Test for overall effect: Z = 0.08 (P = 0.93)

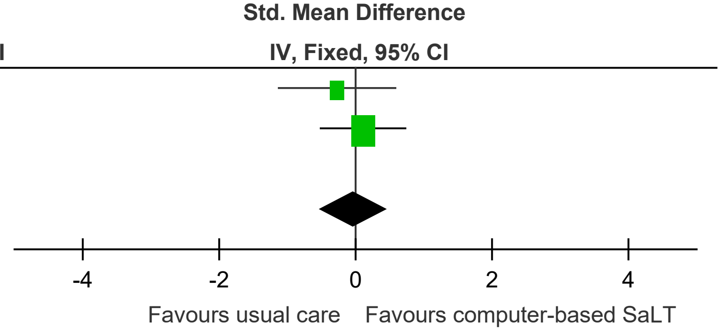


Figure 34: Communication - functional communication (TOMS, 0-10, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Palmer 2019	0.12	0.74	94	0.13	0.79	97	-0.01 [-0.23, 0.21]

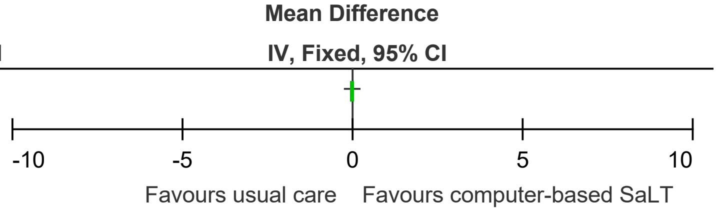


Figure 35: Communication related quality of life (COAST, Quality of Life Questionnaire for Aphasics Total score [different scale ranges], higher values are better, final values) at <3 months

	Computer-based SaLT			Usual care				Std. Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Mitchell 2018	65.3	16.6	23	71	15.3	14	62.1%	-0.35 [-1.02, 0.32]
Spaccavento 2021	59.66	40.49	13	72	24.45	9	37.9%	-0.34 [-1.20, 0.52]
Total (95% CI)			**36**			**23**	**100.0%**	**-0.34 [-0.87, 0.18]**

Heterogeneity: Chi² = 0.00, df = 1 (P = 0.99); I² = 0%
Test for overall effect: Z = 1.28 (P = 0.20)

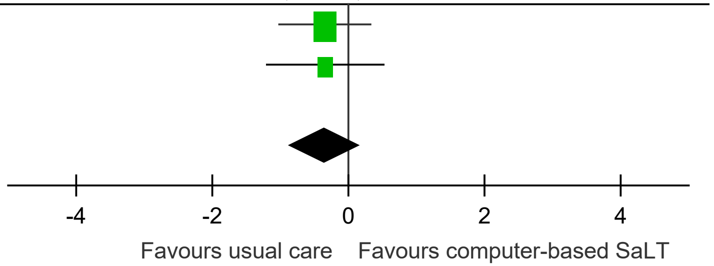


Figure 36: Communication related quality of life (Stroke and Aphasia Quality of Life Scale-39, COAST [different scale ranges], higher values are better, change scores) at ≥3 months

	Computer-based SaLT			Usual care				Std. Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Braley 2021	0.24	0.36	17	0.11	0.4	13	13.2%	0.33 [-0.39, 1.06]
Palmer 2019	5.3	13.9	94	7.4	13.7	97	86.8%	-0.15 [-0.44, 0.13]
Total (95% CI)			**111**			**110**	**100.0%**	**-0.09 [-0.35, 0.18]**

Heterogeneity: Chi² = 1.49, df = 1 (P = 0.22); I² = 33%
Test for overall effect: Z = 0.65 (P = 0.52)

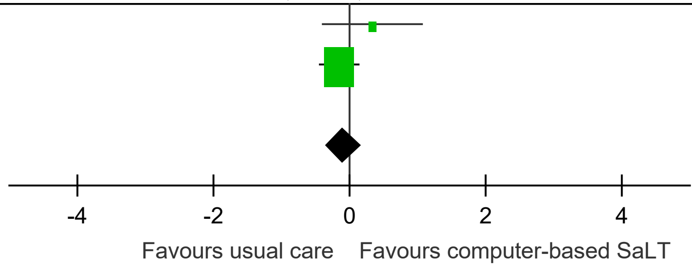


Figure 37: Psychological distress - depression (Aphasic Depression Rating Scale, scale range unclear, higher values are better, final value) at <3 months

	Computer-based SaLT			Usual care			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
De Luca 2018	5.4	2.432632	17	0.5	2.788548	15	4.90 [3.08, 6.72]

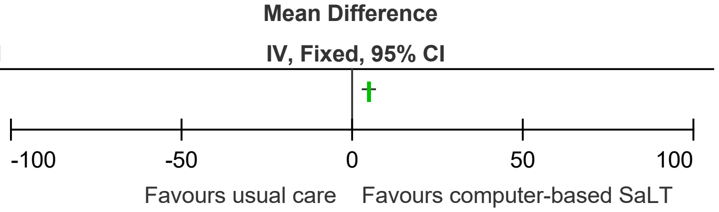


Figure 38: Psychological distress - depression (Aphasic Depression Rating Scale, unclear scale range, higher values are better, change scores) at ≥3 months

	Computer-based SaLT			Usual care				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
De Luca 2018	4.8	2.597557	17	-0.1	2.982197	15	48.3%	4.90 [2.95, 6.85]
Maresca 2019	6.5	2.633629	15	2.3	2.633629	15	51.7%	4.20 [2.32, 6.08]
Total (95% CI)			**32**			**30**	**100.0%**	**4.54 [3.18, 5.89]**

Heterogeneity: Chi² = 0.26, df = 1 (P = 0.61); I² = 0%

Test for overall effect: Z = 6.56 (P < 0.00001)

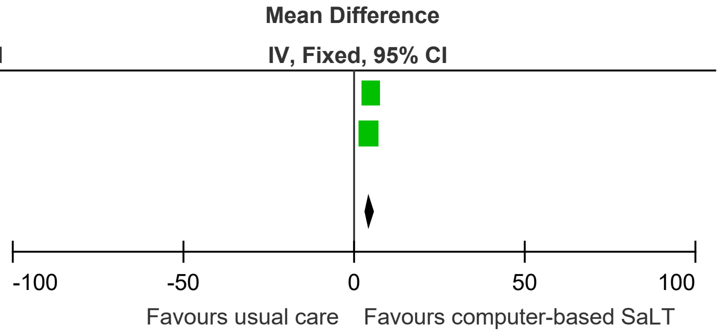


Figure 39: Discontinuation at <3 months

	Computer-based SaLT		Usual care			Risk Difference
Study or Subgroup	**Events**	**Total**	**Events**	**Total**	**Weight**	**M-H, Random, 95% CI**
Kesav 2017	1	12	3	12	13.8%	-0.17 [-0.46, 0.12]
Liu 2021	2	35	0	35	27.2%	0.06 [-0.03, 0.15]
Mitchell 2018	10	26	0	14	19.0%	0.38 [0.18, 0.59]
Ora 2020	2	32	3	30	24.1%	-0.04 [-0.17, 0.10]
Woolf 2016	0	10	0	5	15.9%	0.00 [-0.25, 0.25]
Total (95% CI)		**115**		**96**	**100.0%**	**0.06 [-0.09, 0.20]**
Total events	15		6			

Heterogeneity: Tau² = 0.02; Chi² = 14.12, df = 4 (P = 0.007); I² = 72%
Test for overall effect: Z = 0.76 (P = 0.45)

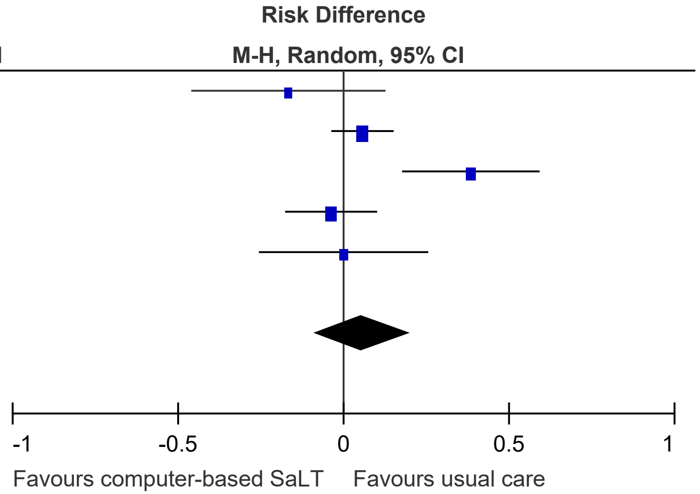
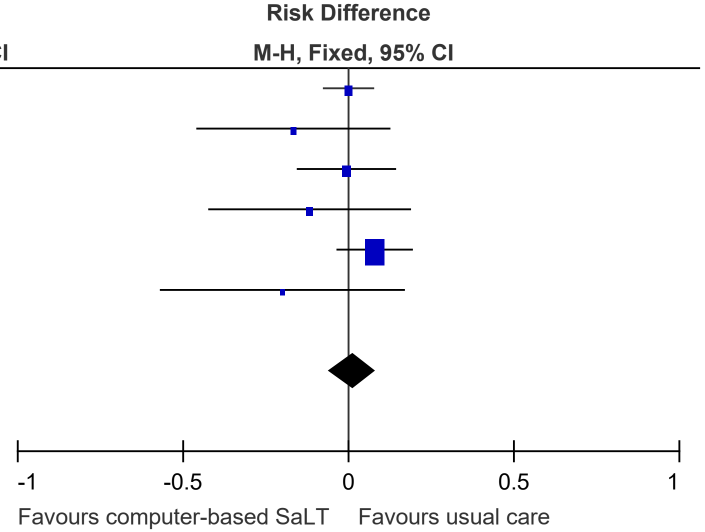


Figure 40: Discontinuation at ≥3 months

	Computer-based SaLT		Usual care			Risk Difference
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% CI
Elhakeem 2021	0	25	0	25	13.1%	0.00 [-0.07, 0.07]
Kesav 2017	1	12	3	12	6.3%	-0.17 [-0.46, 0.12]
Ora 2020	3	32	3	30	16.2%	-0.01 [-0.15, 0.14]
Palmer 2012	4	17	6	17	8.9%	-0.12 [-0.42, 0.19]
Palmer 2019	24	97	17	101	51.9%	0.08 [-0.03, 0.19]
Woolf 2016	0	10	1	5	3.5%	-0.20 [-0.57, 0.17]
Total (95% CI)		**193**		**190**	**100.0%**	**0.01 [-0.06, 0.09]**
Total events	32		30			

Heterogeneity: Chi² = 4.95, df = 5 (P = 0.42); I² = 0%
Test for overall effect: Z = 0.32 (P = 0.75)



E.2 Computer-based tools for speech and language therapy compared to social support/stimulation

Figure 41: Person/participant generic health-related quality of life (EQ-5D-5L, -0.11-1, higher values are better, final value) at ≥3 months

	Computer-based SaLT			Social stimulation			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Palmer 2019	0.59	0.25	97	0.59	0.24	80	0.00 [-0.07, 0.07]

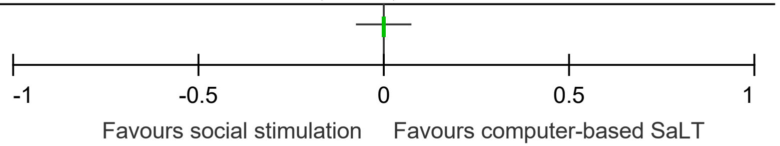


Figure 42: Communication - impairment specific measures (naming) (naming assessment, 0-100, higher values are better, final value) at <3 months

	Computer-based SaLT			Social stimulation			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Woolf 2016	38.6	18.72	10	9.6	10.14	5	29.00 [14.38, 43.62]

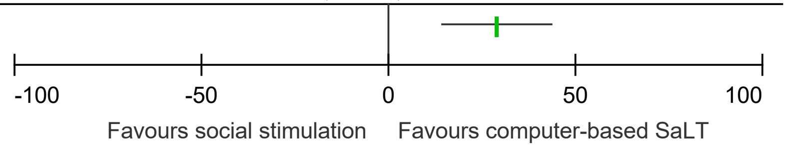


Figure 43: Communication - impairment specific measures (naming) (word finding ability, naming assessment, 0-100/%, higher values are better, change score and final value) at ≥3 months

	Computer-based SaLT			Social stimulation				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Random, 95% CI**
Palmer 2019	16.1	16.6	94	7.7	13.4	79	57.4%	8.40 [3.93, 12.87]
Woolf 2016	38.3	18.72	10	9.8	12.28	5	42.6%	28.50 [12.67, 44.33]
Total (95% CI)			**104**			**84**	**100.0%**	**16.96 [-2.52, 36.44]**

Heterogeneity: Tau² = 166.80; Chi² = 5.74, df = 1 (P = 0.02); I² = 83%
Test for overall effect: Z = 1.71 (P = 0.09)

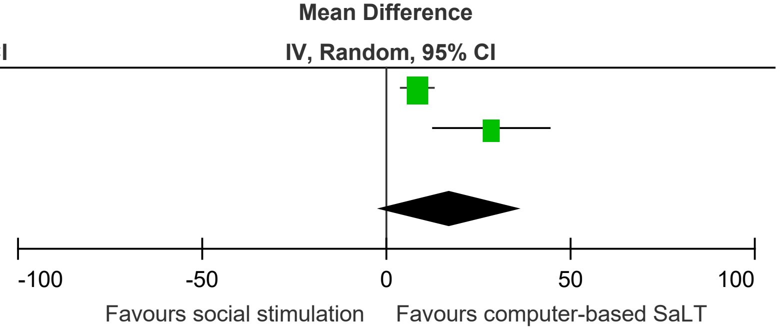


Figure 44: Communication - functional communication (TOMS, 0-10, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Social stimulation			Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**IV, Fixed, 95% CI**
Palmer 2019	0.12	0.74	94	0.09	0.89	79	0.03 [-0.22, 0.28]

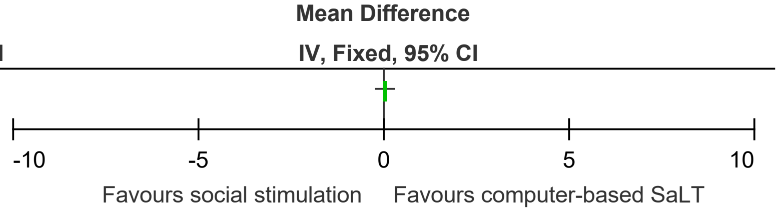


Figure 45: Communication related quality of life (COAST, %, higher values are better, change score) at ≥3 months

	Computer-based SaLT			Social stimulation			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Palmer 2019	5.3	13.9	94	3.4	14.2	79	1.90 [-2.31, 6.11]

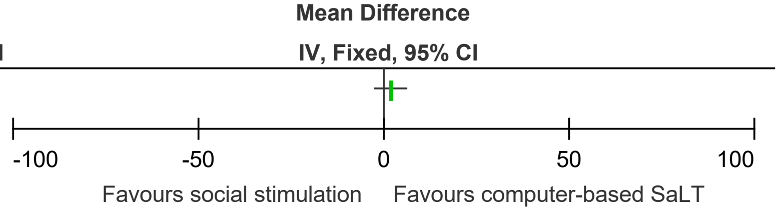


Figure 46: Discontinuation at <3 months

	Computer-based SaLT		Social stimulation		Risk Difference
Study or Subgroup	Events	Total	Events	Total	M-H, Fixed, 95% CI
Woolf 2016	0	10	0	5	0.00 [-0.25, 0.25]

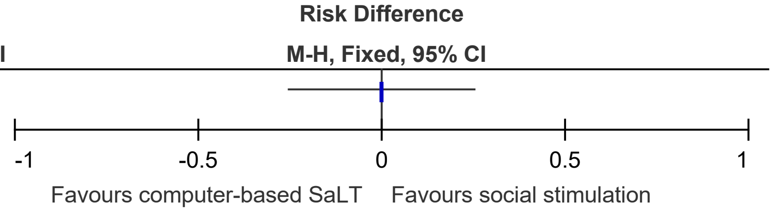
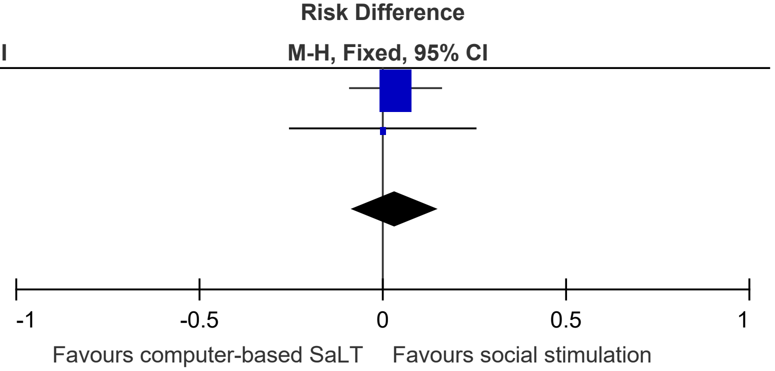


Figure 47: Discontinuation at ≥3 months

	Computer-based SaLT		Social stimulation			Risk Difference
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% CI
Palmer 2019	24	97	17	80	92.9%	0.03 [-0.09, 0.16]
Woolf 2016	0	10	0	5	7.1%	0.00 [-0.25, 0.25]
Total (95% CI)		**107**		**85**	**100.0%**	**0.03 [-0.08, 0.15]**
Total events	24		17			

Heterogeneity: Chi² = 0.06, df = 1 (P = 0.80); I² = 0%

Test for overall effect: Z = 0.54 (P = 0.59)



E.3 Computer-based tools for speech and language therapy compared to no treatment

Figure 48: Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change score and final value) at ≥3 months

	Computer-based tools			No treatment			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Katz 1991	1.6	3.2	10	-1.4	2.3	5	3.00 [0.17, 5.83]

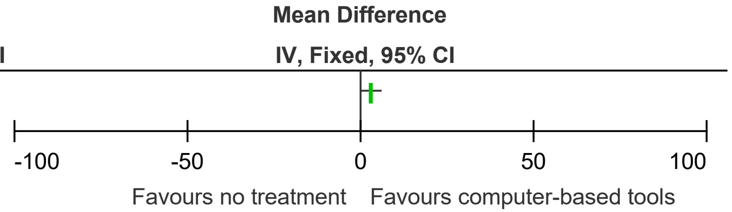


Figure 49: Communication - impairment specific measures (naming) (verbal fluency, items, higher values are better, final value) at <3 months

	Computer-based tools			No treatment			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI	IV, Fixed, 95% CI
Marshall 2016	82	38.2	10	62.5	20.98	10	19.50 [-7.51, 46.51]	

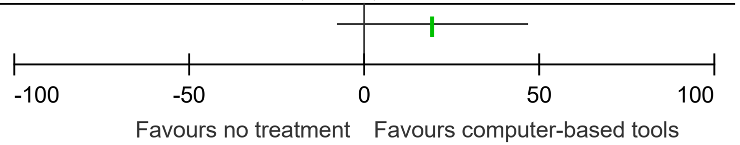


Figure 50: Communication - impairment specific measures (reading) (Reading Comprehension Battery for Aphasia subtests 7-9, 0-30, higher values are better, final value) at <3 months

	Computer-based tools			No treatment			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI	IV, Fixed, 95% CI
Caute 2019	20.27	7.9	11	19.8	7.35	10	0.47 [-6.05, 6.99]	

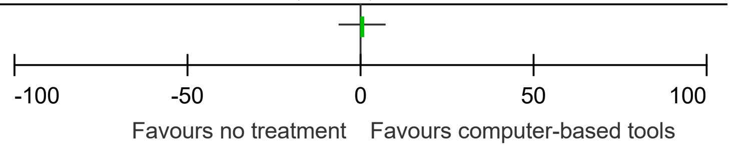


Figure 51: Communication - functional communication (Communication Activities of Daily Living [different scale ranges], higher values are better, final values) at <3 months

	Computer-based tools			No treatment				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Caute 2019	79.09	23.11	11	88.2	6.46	10	50.6%	-0.50 [-1.38, 0.37]
Marshall 2016	7.2	1.55	10	6.1	1.19	10	49.4%	0.76 [-0.15, 1.68]
Total (95% CI)			**21**			**20**	**100.0%**	**0.12 [-1.12, 1.36]**

Heterogeneity: Tau² = 0.59; Chi² = 3.85, df = 1 (P = 0.05); I² = 74%
Test for overall effect: Z = 0.19 (P = 0.85)

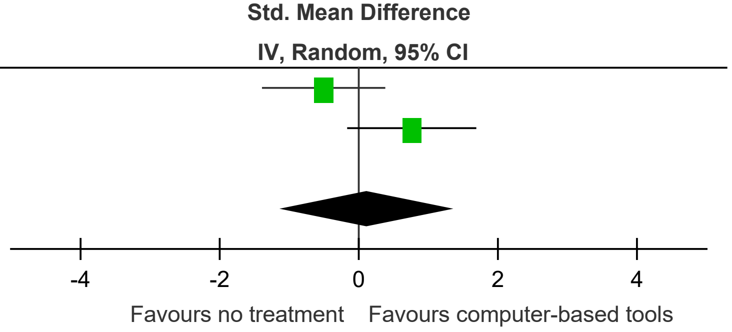


Figure 52: Communication - functional communication (Communication Activities of Daily Living, 0-100, higher values are better, final value) at ≥3 months

	Computer-based tools			No treatment			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Marshall 2020	89.81	7.61	16	83	8.49	18	6.81 [1.40, 12.22]

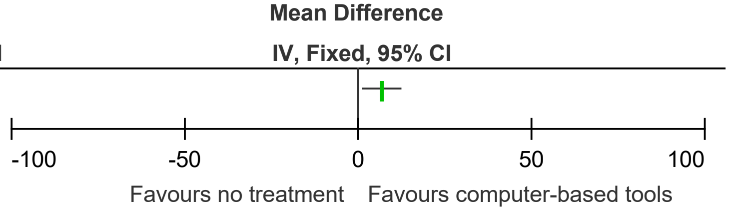


Figure 53: Communication related quality of life (Assessment of Living with Aphasia, 0-4, higher values are better, final value) at <3 months

	Computer-based tools			No treatment			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI	IV, Fixed, 95% CI
Caute 2019	2.83	0.61	11	2.48	0.74	10	0.35 [-0.23, 0.93]	

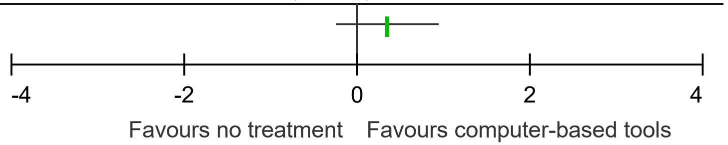


Figure 54: Communication related quality of life (Stroke aphasia quality of life-39 generic, 1-5, higher values are better, final value) at ≥3 months

	Computer-based tools			No treatment			Mean Difference	Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI	IV, Fixed, 95% CI
Marshall 2020	3.73	0.72	16	3.35	0.65	18	0.38 [-0.08, 0.84]	

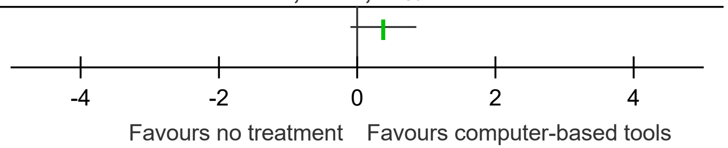


Figure 55: Psychological distress - depression (Visual analog mood scales revised version, 0-100, lower values are better, final value) at <3 months

	Computer-based tools			No treatment			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Caute 2019	56	18.93	11	55.7	13.63	10	0.30 [-13.72, 14.32]

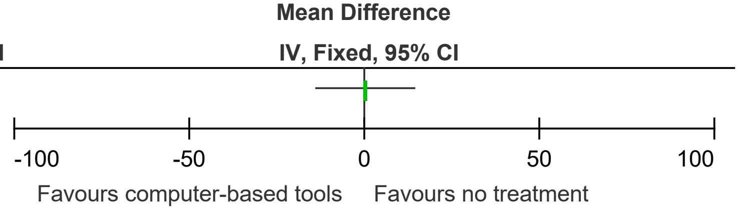


Figure 56: Discontinuation at <3 months

	Computer-based tools		No treatment			Risk Difference
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% CI
Caute 2019	0	11	0	10	51.2%	0.00 [-0.17, 0.17]
Marshall 2016	0	10	0	10	48.8%	0.00 [-0.17, 0.17]
Total (95% CI)		**21**		**20**	**100.0%**	**0.00 [-0.13, 0.13]**
Total events	0		0			

Heterogeneity: Chi² = 0.00, df = 1 (P = 1.00); I² = 0%

Test for overall effect: Z = 0.00 (P = 1.00)

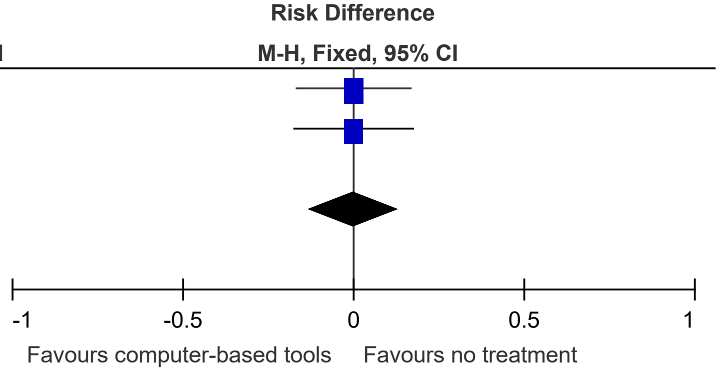
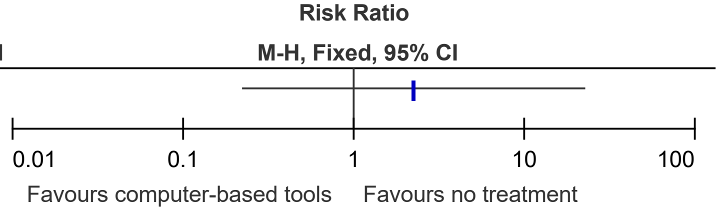


Figure 57: Discontinuation at ≥3 months

	Computer-based tools		No treatment		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	M-H, Fixed, 95% CI
Marshall 2020	2	16	1	18	2.25 [0.22, 22.53]



E.4 Computer-based tools for speech and language therapy compared to placebo

Figure 58: Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change score) at <3 months

			Computer-based SaLT	Placebo	Mean Difference
Study or Subgroup	Mean Difference	SE	Total	Total	IV, Fixed, 95% CI
Cherney 2021	0.99	0.249	19	13	0.99 [0.50, 1.48]

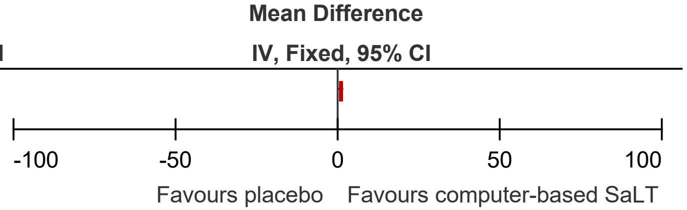


Figure 59: Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change score) at ≥3 months

Study or Subgroup	Mean Difference	SE	Computer-based SaLT Total	Placebo Total	Weight	Mean Difference IV, Random, 95% CI
Cherney 2021	2.7	0.5	16	13	60.4%	2.70 [1.72, 3.68]
Katz 1991	0.6	1.0802	10	7	39.6%	0.60 [-1.52, 2.72]
Total (95% CI)			**26**	**20**	**100.0%**	**1.87 [-0.14, 3.88]**

Heterogeneity: Tau² = 1.50; Chi² = 3.11, df = 1 (P = 0.08); I² = 68%
Test for overall effect: Z = 1.82 (P = 0.07)

Mean Difference IV, Random, 95% CI

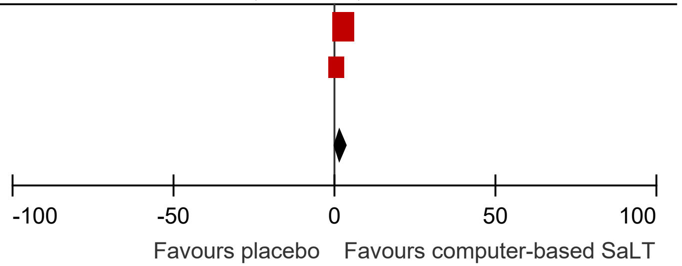


Figure 60: Communication - impairment specific measures (naming) (naming accuracy, unclear scale range, higher values are better, final value, crossover trial) at <3 months

Study or Subgroup	Computer-based SaLT Mean	SD	Total	Placebo Mean	SD	Total	Mean Difference IV, Fixed, 95% CI
Varley 2016	15.79	8.14	50	13.99	8.75	50	1.80 [-1.51, 5.11]

Mean Difference IV, Fixed, 95% CI

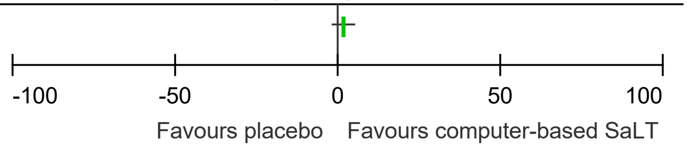


Figure 61: Discontinuation at <3 months

	Computer-based SaLT		Placebo		Peto Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Peto, Fixed, 95% CI
Cherney 2021	3	19	0	13	6.05 [0.56, 65.53]

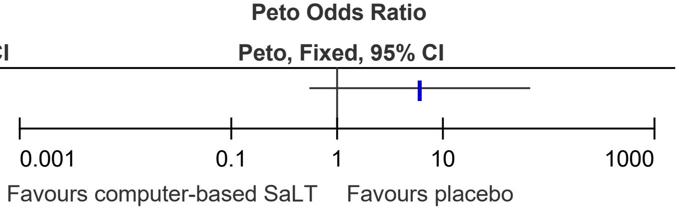
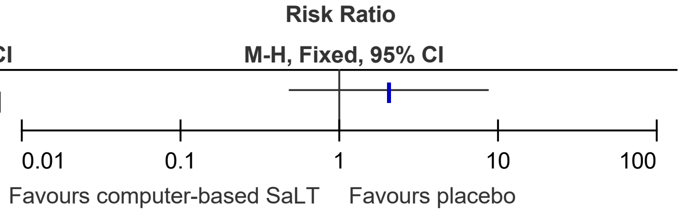


Figure 62: Discontinuation at ≥3 months

	Computer-based SaLT		Placebo		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	M-H, Fixed, 95% CI
Cherney 2021	6	19	2	13	2.05 [0.49, 8.63]



Appendix F – GRADE tables

Table 13: Clinical evidence profile: computer-based tools for speech and language therapy compared to speech and language therapy without computer-based tools (usual care)

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	speech and language therapy without computer-based tools (usual care)	Relative (95% CI)	Absolute (95% CI)		
Person/participant generic health-related quality of life (EuroQol-5D, 0-100, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	very serious[a]	not serious	not serious	not serious	none	15	15	-	MD **13.3 higher** (9.23 higher to 17.37 higher)	⊕⊕◯◯ Low	CRITICAL
Person/participant generic health-related quality of life (EQ-5D-5L, -0.11-1, higher values are better, final value) at ≥3 months (follow-up: 12 months)												
1	randomised trials	not serious	not serious	not serious	serious[b]	none	97	101	-	MD **0.06 lower** (0.13 lower to 0.01 higher)	⊕⊕⊕◯ Moderate	CRITICAL
Communication - overall language ability (Western Aphasia Battery Aphasia Quotient, 0-100, higher values are better, change scores and final values) at <3 months (follow-up: mean 4 weeks)												
3	randomised trials	very serious[a]	very serious[c]	not serious	serious[b]	none	64	64	-	MD **11.91 higher** (7.79 higher to 16.03 higher)	⊕◯◯◯ Very low	CRITICAL
Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change scores and final value) at ≥3 months (follow-up: mean 3 months)												
3	randomised trials	very serious[a]	not serious	not serious	not serious	none	39	38	-	MD **4.94 higher** (2.09 higher to 7.78 higher)	⊕⊕◯◯ Low	CRITICAL
Communication - overall language ability (Aphasia severity rating scale, 0-5, higher values are better, change score) at ≥3 months (follow-up: 6 months)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	speech and language therapy without computer-based tools (usual care)	Relative (95% CI)	Absolute (95% CI)		
1	randomised trials	not serious	not serious	not serious	very serious[b]	none	25	25	-	MD **0.04 higher** (0.43 lower to 0.51 higher)	⊕⊕◯◯ Low	CRITICAL
Communication - impairment specific measures (naming) (Western Aphasia Battery oral naming, scale range unclear, higher values are better, change score) at <3 months (follow-up: 4 weeks)												
1	randomised trials	very serious[d]	not serious	not serious	serious[b]	none	33	35	-	MD **0.89 higher** (0.39 lower to 2.17 higher)	⊕◯◯◯ Very low	CRITICAL
Communication - impairment specific measures (naming) (Western Aphasia Battery naming and word finding subscale, NGA subscale naming, AAT naming subtest, naming assessment [different scale ranges], higher values are better, final values) at <3 months (follow-up: mean 7 weeks)												
5	randomised trials	very serious[a]	not serious	not serious	not serious	none	97	86	-	SMD **0.12 SD lower** (0.41 lower to 0.18 higher)	⊕⊕◯◯ Low	CRITICAL
Communication - impairment specific measures (naming) (Boston Naming Test, items, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	serious[b]	none	25	25	-	MD **9.96 higher** (3.75 higher to 16.17 higher)	⊕⊕⊕◯ Moderate	CRITICAL
Communication - impairment specific measures (naming) (words named correctly, word finding ability, %, higher values are better, change scores) at ≥3 months (follow-up: mean 10 months)												
2	randomised trials	not serious	not serious	not serious	serious[b]	none	107	108	-	MD **10.82 higher** (6.21 higher to 15.42 higher)	⊕⊕⊕◯ Moderate	CRITICAL
Communication - impairment specific measures (naming) (NGA subtest naming, Naming Assessment, 0-100, higher values are better, final values) at ≥3 months (follow-up: mean 4 months)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	speech and language therapy without computer-based tools (usual care)	Relative (95% CI)	Absolute (95% CI)		
2	randomised trials	not serious	not serious	not serious	very serious[b]	none	42	34	-	MD **3.08 lower** (13.38 lower to 7.23 higher)	⨁⨁◯◯ Low	CRITICAL
Communication - impairment specific measures (auditory comprehension) (Western Aphasia Battery auditory comprehension, scale range unclear, higher values are better, change score) at <3 months (follow-up: 4 weeks)												
1	randomised trials	very serious[d]	not serious	not serious	not serious	none	33	35	-	MD **0.13 lower** (0.66 lower to 0.4 higher)	⨁⨁◯◯ Low	CRITICAL
Communication - impairment specific measures (auditory comprehension) (Western Aphasia Battery comprehension subtest, NGA comprehension subtest, AAT token subtest [different scale ranges], higher values are better, final values) at <3 months (follow-up: mean 7 weeks)												
4	randomised trials	not serious	not serious	not serious	not serious	none	87	81	-	SMD **0.02 SD lower** (0.33 lower to 0.28 higher)	⨁⨁⨁⨁ High	CRITICAL
Communication - impairment specific measures (auditory comprehension) (Token test, 0-36, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	very serious[a]	not serious	not serious	not serious	none	15	15	-	MD **5.3 lower** (6.94 lower to 3.66 lower)	⨁⨁◯◯ Low	CRITICAL
Communication - impairment specific measures (auditory comprehension) (BDAE complex ideational material subtest, 0-10, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	not serious	none	25	25	-	MD **0.2 higher** (1.27 lower to 1.67 higher)	⨁⨁⨁⨁ High	CRITICAL
Communication - impairment specific measures (auditory comprehension) (BDAE commands subtest, 0-24, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	not serious	none	25	25	-	MD **0.08 higher** (2 lower to 2.16 higher)	⨁⨁⨁⨁ High	CRITICAL

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	speech and language therapy without computer-based tools (usual care)	Relative (95% CI)	Absolute (95% CI)		
Communication - impairment specific measures (auditory comprehension) (BDAE basic word discrimination subtest, 0-72, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	not serious	none	25	25	-	MD **0.2 higher** (4.72 lower to 5.12 higher)	⊕⊕⊕⊕ High	CRITICAL
Communication - impairment specific measures (auditory comprehension) (NGA subtest comprehension, 0-100, higher values are better, final value) at ≥3 months (follow-up: 4 months)												
1	randomised trials	not serious	not serious	not serious	very serious[b]	none	32	30	-	MD **0.5 lower** (13.94 lower to 12.94 higher)	⊕⊕◯◯ Low	CRITICAL
Communication - impairment specific measures (reading) (Functional Assessment Measure Reading, 0-7, higher values are better, final value) at <3 months (follow-up: 8 weeks)												
1	randomised trials	not serious	not serious	not serious	very serious[b]	none	13	9	-	MD **0.05 higher** (1.12 lower to 1.22 higher)	⊕⊕◯◯ Low	CRITICAL
Communication - impairment specific measures (reading) (Western Aphasia Battery reading, 0-100, higher values are better, change score) at ≥3 months (follow-up: 3 months)												
1	randomised trials	very serious[d]	not serious	not serious	serious[b]	none	11	14	-	MD **4.91 lower** (15.18 lower to 5.36 higher)	⊕◯◯◯ Very low	CRITICAL
Communication - impairment specific measures (reading) (BDAE basic oral reading subtest, 0-30, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	not serious	none	25	25	-	MD **0.09 higher** (3.12 lower to 3.3 higher)	⊕⊕⊕⊕ High	CRITICAL
Communication - impairment specific measures (reading) (BDAE oral reading of sentences with comprehension, 0-10, higher values are better, change score) at ≥3 months (follow-up: 6 months)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	speech and language therapy without computer-based tools (usual care)	Relative (95% CI)	Absolute (95% CI)		
1	randomised trials	not serious	not serious	not serious	not serious	none	25	25	-	MD **0.07 higher** (0.98 lower to 1.12 higher)	⊕⊕⊕⊕ High	CRITICAL
Communication - impairment specific measures (expressive language) (Western Aphasia Battery Spontaneous speech, scale range unclear, higher values are better, change score) at <3 months (follow-up: 4 weeks)												
1	randomised trials	very serious[d]	not serious	not serious	serious[b]	none	33	35	-	MD **1.73 higher** (0.48 higher to 2.98 higher)	⊕◯◯◯ Very low	CRITICAL
Communication - impairment specific measures (expressive language) (Western Aphasia Battery Spontaneous speech, Functional Assessment Measure Expression, [different scale ranges], higher values are better, final values) at <3 months (follow-up: mean 9 weeks)												
2	randomised trials	very serious[e]	not serious	not serious	serious[b]	none	35	31	-	SMD **0.12 SD lower** (0.61 lower to 0.36 higher)	⊕◯◯◯ Very low	CRITICAL
Communication - impairment specific measures (expressive language) (BDAE articulatory agility subtest, 1-7, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	serious[b]	none	25	25	-	MD **0.2 higher** (0.34 lower to 0.74 higher)	⊕⊕⊕◯ Moderate	CRITICAL
Communication - impairment specific measures (expressive language) (BDAE grammatical forms subtest, 1-7, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	serious[b]	none	25	25	-	MD **0.48 higher** (0.13 lower to 1.09 higher)	⊕⊕⊕◯ Moderate	CRITICAL
Communication - impairment specific measures (expressive language) (BDAE melodic line subtest, 1-7, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	serious[b]	none	25	25	-	MD **1 higher** (0.41 higher to 1.59 higher)	⊕⊕⊕◯ Moderate	CRITICAL

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	speech and language therapy without computer-based tools (usual care)	Relative (95% CI)	Absolute (95% CI)		
Communication - impairment specific measures (expressive language) (BDAE paraphrasia subtest, 1-7, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	serious[b]	none	25	25	-	MD **1.64 higher** (0.46 higher to 2.82 higher)	⨁⨁⨁◯ Moderate	CRITICAL
Communication - impairment specific measures (expressive language) (BDAE phrase length subtest, 1-7, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	serious[b]	none	25	25	-	MD **0.68 higher** (0.12 higher to 1.24 higher)	⨁⨁⨁◯ Moderate	CRITICAL
Communication - impairment specific measures (expressive language) (BDAE word-finding relative to fluency subtest, 1-7, higher values are better, change score) at ≥3 months (follow-up: 6 months)												
1	randomised trials	not serious	not serious	not serious	serious[b]	none	25	25	-	MD **0.8 higher** (0 to 1.6 higher)	⨁⨁⨁◯ Moderate	CRITICAL
Communication - impairment specific measures (dysarthria - speech impairment) (Frenchay Dysarthria Assessment-II, unclear scale range, higher values are better, final value) at <3 months (follow-up: 10 weeks)												
1	randomised trials	very serious[f]	not serious	not serious	serious[b]	none	23	14	-	MD **7 lower** (26.05 lower to 12.05 higher)	⨁◯◯◯ Very low	CRITICAL
Communication - impairment specific measures (dysarthria - activity) (Dysarthria Therapy Outcome Measures, unclear scale range, higher values are better, final value) at <3 months (follow-up: 10 weeks)												
1	randomised trials	very serious[f]	not serious	not serious	serious[b]	none	23	14	-	MD **0.3 lower** (0.85 lower to 0.25 higher)	⨁◯◯◯ Very low	CRITICAL
Communication - functional communication (Communication activities of daily living, functional outcome questionnaire aphasia total score [different scale ranges], higher values are better, final values) at <3 months (follow-up: mean 6 weeks)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	speech and language therapy without computer-based tools (usual care)	Relative (95% CI)	Absolute (95% CI)		
2	randomised trials	very serious[a]	not serious	not serious	serious[b]	none	33	29	-	SMD **0.02 SD lower** (0.52 lower to 0.48 higher)	⨁◯◯◯ Very low	CRITICAL
Communication - functional communication (TOMS, 0-10, higher values are better, change score) at ≥3 months (follow-up: 12 months)												
1	randomised trials	not serious	not serious	not serious	not serious	none	94	97	-	MD **0.01 lower** (0.23 lower to 0.21 higher)	⨁⨁⨁⨁ High	CRITICAL
Communication related quality of life (COAST, Quality of Life Questionnaire for Aphasics Total score [different scale ranges], higher values are better, final values) at <3 months (follow-up: mean 9 weeks)												
2	randomised trials	very serious[g]	not serious	not serious	serious[b]	none	36	23	-	SMD **0.34 SD lower** (0.87 lower to 0.18 higher)	⨁◯◯◯ Very low	CRITICAL
Communication related quality of life (Stroke and Aphasia Quality of Life Scale-39, COAST [different scale ranges], higher values are better, change scores) at ≥3 months (follow-up: mean 8 months)												
2	randomised trials	not serious	not serious	not serious	not serious	none	111	110	-	SMD **0.09 SD lower** (0.35 lower to 0.18 higher)	⨁⨁⨁⨁ High	CRITICAL
Psychological distress - depression (Aphasic Depression Rating Scale, scale range unclear, higher values are better, final value) at <3 months (follow-up: 8 weeks)												
1	randomised trials	very serious[h]	not serious	not serious	serious[b]	none	17	15	-	MD **4.9 higher** (3.08 higher to 6.72 higher)	⨁◯◯◯ Very low	CRITICAL
Psychological distress - depression (Aphasic Depression Rating Scale, unclear scale range, higher values are better, change scores) at ≥3 months (follow-up: mean 6 months)												
2	randomised trials	not serious	not serious	not serious	serious[b]	none	32	30	-	MD **4.54 higher** (3.18 higher to 5.89 higher)	⨁⨁⨁◯ Moderate	CRITICAL

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	speech and language therapy without computer-based tools (usual care)	Relative (95% CI)	Absolute (95% CI)		
Discontinuation at <3 months (follow-up: mean 6 weeks)												
5	randomised trials	very serious[a]	serious[i]	not serious	very serious[b]	none	15/115 (13.0%)	6/96 (6.3%)	**RD 0.06** (-0.09 to 0.20)	**60 more per 1,000** (from 90 fewer to 200 more)[j]	⨁◯◯◯ Very low	CRITICAL
Discontinuation at ≥3 months (follow-up: mean 6 months)												
6	randomised trials	not serious	serious[i]	not serious	very serious[b]	none	32/193 (16.6%)	30/190 (15.8%)	**RD 0.01** (-0.06 to 0.09)	**10 more per 1,000** (from 60 fewer to 90 more)[j]	⨁◯◯◯ Very low	CRITICAL

CI: confidence interval; **MD:** mean difference; **SMD:** standardised mean difference

Explanations

a. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in measurement of the outcome)

b. Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs

c. Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis

d. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions and bias in measurement of the outcome)

e. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions and bias due to missing outcome data)

f. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias due to deviations from the intended interventions and bias due to missing outcome data)

g. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias due to deviations from the intended interventions and bias due to missing outcome data)

h. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in selection of the reported result)

i. Downgraded for heterogeneity due to conflicting number of events in different studies (zero events in one or more studies)

j. Absolute effect calculated by risk difference due to zero events in at least one arm of one study

Table 14: Clinical evidence profile: computer-based tools for speech and language therapy compared to social support/stimulation

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	social support/stimulation	Relative (95% CI)	Absolute (95% CI)		
Person/participant generic health-related quality of life (EQ-5D-5L, -0.11-1, higher values are better, final value) at ≥3 months (follow-up: 12 months)												
1	randomised trials	not serious	not serious	not serious	very serious[a]	none	97	80	-	MD **0** (0.07 lower to 0.07 higher)	⊕⊕◯◯ Low	CRITICAL
Communication - impairment specific measures (naming) (naming assessment, 0-100, higher values are better, final value) at <3 months (follow-up: 8 weeks)												
1	randomised trials	very serious[b]	not serious	not serious	not serious	none	10	5	-	MD **29 higher** (14.38 higher to 43.62 higher)	⊕⊕◯◯ Low	CRITICAL
Communication - impairment specific measures (naming) (word finding ability, naming assessment, 0-100/%, higher values are better, change score and final value) at ≥3 months (follow-up: mean 8 months)												
2	randomised trials	not serious	very serious[c]	not serious	serious[a]	none	104	84	-	MD **16.96 higher** (2.52 lower to 36.44 higher)	⊕◯◯◯ Very low	CRITICAL
Communication - functional communication (TOMS, 0-10, higher values are better, change score) at ≥3 months (follow-up: 12 months)												
1	randomised trials	not serious	not serious	not serious	not serious	none	94	79	-	MD **0.03 higher** (0.22 lower to 0.28 higher)	⊕⊕⊕⊕ High	CRITICAL
Communication related quality of life (COAST, %, higher values are better, change score) at ≥3 months (follow-up: 12 months)												
1	randomised trials	not serious	not serious	not serious	not serious	none	94	79	-	MD **1.9 higher** (2.31 lower to 6.11 higher)	⊕⊕⊕⊕ High	CRITICAL

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	social support/stimulation	Relative (95% CI)	Absolute (95% CI)		
Discontinuation at <3 months (follow-up: 8 weeks)												
1	randomised trials	very serious[b]	not serious	not serious	very serious[d]	none	0/10 (0.0%)	0/5 (0.0%)	**RD 0.00** (-0.25 to 0.25)	**0 fewer per 1,000** (from 250 fewer to 250 more)[e]	⊕◯◯◯ Very low	CRITICAL
Discontinuation at ≥3 months (follow-up: mean 8 months)												
2	randomised trials	not serious	serious[f]	not serious	very serious[d]	none	24/107 (22.4%)	17/85 (20.0%)	**RD 0.03** (-0.08 to 0.15)	**30 more per 1,000** (from 80 fewer to 150 more)[e]	⊕◯◯◯ Very low	CRITICAL

CI: confidence interval; **MD:** mean difference

Explanations

a. Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs

b. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process)

c. Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis

d. Downgraded by 1 to 2 increments for imprecision due to zero events and small sample size

e. Absolute effect calculated by risk difference due to zero events in at least one arm of one study

f. Downgraded for heterogeneity due to conflicting number of events in different studies (zero events in one or more studies)

Table 15: Clinical evidence profile: computer-based tools for speech and language therapy compared to no treatment

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	no treatment	Relative (95% CI)	Absolute (95% CI)		
Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change score and final value) at ≥3 months (follow-up: mean 5 months)												
2	randomised trials	very serious[a]	serious[b]	not serious	serious[c]	none	26	23	-	MD **5.39 higher** (1.16 lower to 11.95 higher)	⨁◯◯◯ Very low	CRITICAL
Communication - impairment specific measures (naming) (verbal fluency, items, higher values are better, final value) at <3 months (follow-up: 7 weeks)												
1	randomised trials	very serious[d]	not serious	not serious	serious[c]	none	10	10	-	MD **19.5 higher** (7.51 lower to 46.51 higher)	⨁◯◯◯ Very low	CRITICAL
Communication - impairment specific measures (reading) (Reading Comprehension Battery for Aphasia subtests 7-9, 0-30, higher values are better, final value) at <3 months (follow-up: 6 weeks)												
1	randomised trials	very serious[e]	not serious	not serious	very serious[c]	none	11	10	-	MD **0.47 higher** (6.05 lower to 6.99 higher)	⨁◯◯◯ Very low	CRITICAL
Communication - functional communication (Communication Activities of Daily Living [different scale ranges], higher values are better, final values) at <3 months (follow-up: mean 7 weeks)												
2	randomised trials	very serious[f]	serious[b]	not serious	very serious[c]	none	21	20	-	SMD **0.12 SD higher** (1.12 lower to 1.36 higher)	⨁◯◯◯ Very low	CRITICAL
Communication - functional communication (Communication Activities of Daily Living, 0-100, higher values are better, final value) at ≥3 months (follow-up: 6 months)												
1	randomised trials	very serious[g]	not serious	not serious	serious[c]	none	16	18	-	MD **6.81 higher** (1.4 higher to 12.22 higher)	⨁◯◯◯ Very low	CRITICAL
Communication related quality of life (Assessment of Living with Aphasia, 0-4, higher values are better, final value) at <3 months (follow-up: 6 weeks)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	no treatment	Relative (95% CI)	Absolute (95% CI)		
1	randomised trials	very serious[e]	not serious	not serious	serious[c]	none	11	10	-	MD **0.35 higher** (0.23 lower to 0.93 higher)	⊕◯◯◯ Very low	CRITICAL
Communication related quality of life (Stroke aphasia quality of life-39 generic, 1-5, higher values are better, final value) at ≥3 months (follow-up: 6 months)												
1	randomised trials	serious[g]	not serious	not serious	serious[c]	none	16	18	-	MD **0.38 higher** (0.08 lower to 0.84 higher)	⊕⊕◯◯ Low	CRITICAL
Psychological distress - depression (Visual analog mood scales revised version, 0-100, lower values are better, final value) at <3 months (follow-up: 6 weeks)												
1	randomised trials	very serious[e]	not serious	not serious	very serious[c]	none	11	10	-	MD **0.3 higher** (13.72 lower to 14.32 higher)	⊕◯◯◯ Very low	CRITICAL
Discontinuation at <3 months (follow-up: mean 7 weeks)												
2	randomised trials	very serious[d]	not serious	not serious	very serious[h]	none	0/21 (0.0%)	0/20 (0.0%)	**RD 0.00** (-0.13 to 0.13)	**0 fewer per 1,000** (from 130 fewer to 130 more)[i]	⊕◯◯◯ Very low	CRITICAL
Discontinuation at ≥3 months (follow-up: 6 months)												
1	randomised trials	serious[g]	not serious	not serious	very serious[c]	none	2/16 (12.5%)	1/18 (5.6%)	**RR 2.25** (0.22 to 22.53)	**69 more per 1,000** (from 43 fewer to 1,000 more)	⊕◯◯◯ Very low	CRITICAL

CI: confidence interval; **MD:** mean difference; **RR:** risk ratio; **SMD:** standardised mean difference

Explanations

a. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in measurement of the outcome)

b. Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis

c. Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs

d. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process and bias due to deviations from the intended interventions)

e. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process and bias in measurement of the outcome)

f. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions and bias in measurement of the outcome)

g. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process)

h. Downgraded by 1 to 2 increments for imprecision due to zero events and small sample size

i. Absolute effect calculated by risk difference due to zero events in at least one arm of one study

Table 16: Clinical evidence profile: computer-based tools for speech and language therapy compared to placebo

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	placebo	Relative (95% CI)	Absolute (95% CI)		
Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change score) at <3 months (follow-up: 6 weeks)												
1	randomised trials	very serious[a]	not serious	not serious	not serious	none	19	13	-	MD **0.99 higher** (0.5 higher to 1.48 higher)	⊕⊕◯◯ Low	CRITICAL
Communication - overall language ability (Western Aphasia Battery AQ, 0-100, higher values are better, change score) at ≥3 months (follow-up: mean 3 months)												
2	randomised trials	very serious[a]	serious[b]	not serious	not serious	none	26	20	-	MD **1.87 higher** (0.14 lower to 3.88 higher)	⊕◯◯◯ Very low	CRITICAL
Communication - impairment specific measures (naming) (naming accuracy, unclear scale range, higher values are better, final value, crossover trial) at <3 months (follow-up: 6 weeks)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Computer-based tools for speech and language therapy	placebo	Relative (95% CI)	Absolute (95% CI)		
1	randomised trials	serious[c]	not serious	not serious	serious[d]	none	50	50	-	MD **1.8 higher** (1.51 lower to 5.11 higher)	⊕⊕◯◯ Low	CRITICAL
Discontinuation at <3 months (follow-up: 6 weeks)												
1	randomised trials	very serious[e]	not serious	not serious	very serious[d]	none	3/19 (15.8%)	0/13 (0.0%)	**OR 6.05** (0.56 to 65.53)[f]	**160 more per 1,000** (from 30 fewer to 350 more)[f]	⊕◯◯◯ Very low	CRITICAL
Discontinuation at ≥3 months (follow-up: 3 months)												
1	randomised trials	very serious[e]	not serious	not serious	very serious[d]	none	6/19 (31.6%)	2/13 (15.4%)	**RR 2.05** (0.49 to 8.63)	**162 more per 1,000** (from 78 fewer to 1,000 more)	⊕◯◯◯ Very low	CRITICAL

CI: confidence interval; **MD:** mean difference; **OR:** odds ratio; **RR:** risk ratio

Explanations

a. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias arising from the randomisation process, bias due to deviations from the intended interventions, bias due to missing outcome data and bias in measurement of the outcome)

b. Downgraded by 1 or 2 increments because heterogeneity, unexplained by subgroup analysis

c. Downgraded by 1 increment as the majority of the evidence was of high risk of bias (due to bias arising from the randomisation process)

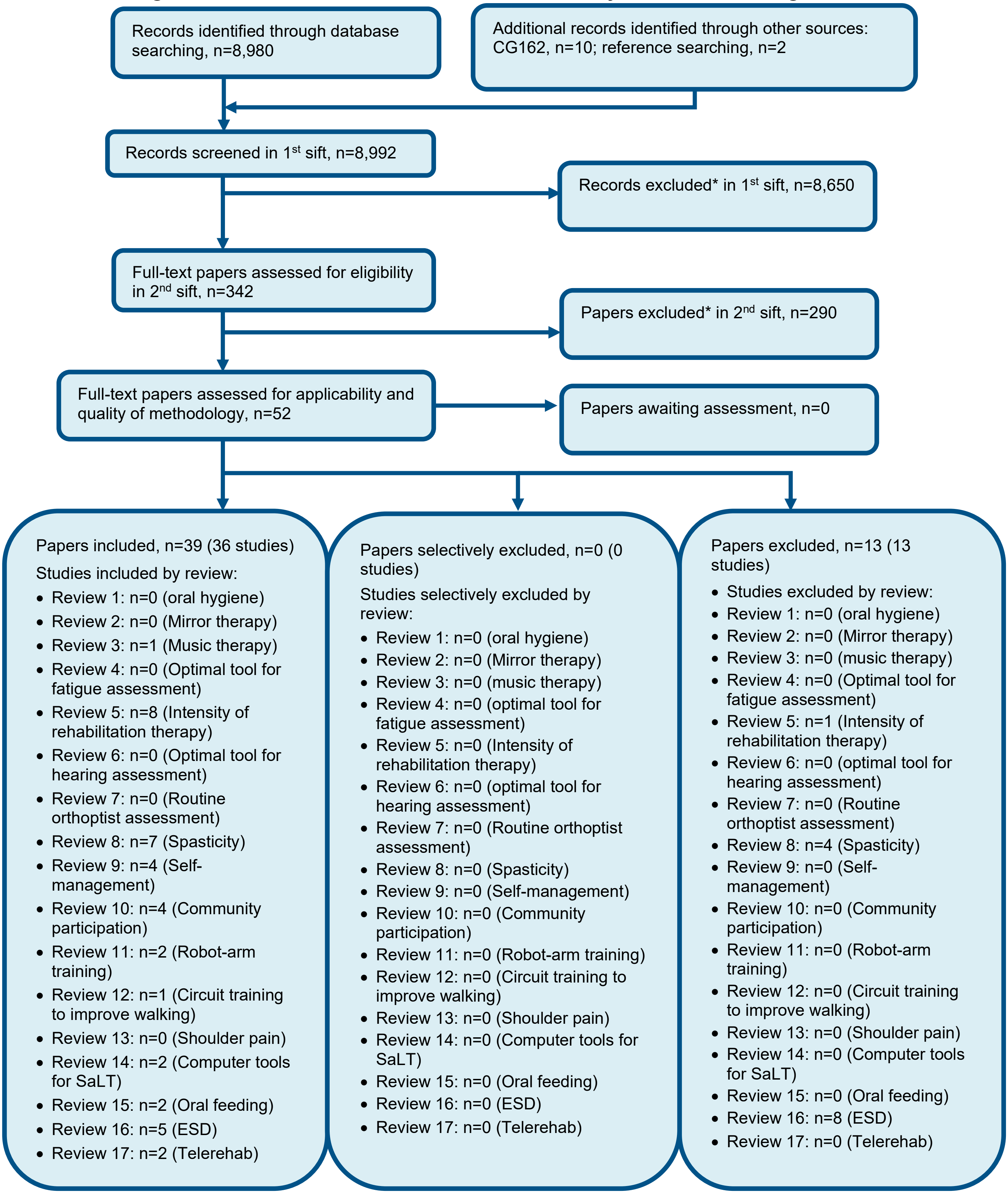
d. Downgraded by 1 increment if the confidence interval crossed one MID or by 2 increments if the confidence interval crossed both MIDs

e. Downgraded by 2 increments as the majority of the evidence was of very high risk of bias (due to bias due to deviations from the intended interventions and bias due to missing outcome data)

f. Absolute effect calculated by risk difference due to zero events in at least one arm of one study

Appendix G – Economic evidence study selection

Figure 1: Flow chart of health economic study selection for the guideline



* Non-relevant population, intervention, comparison, design or setting; non-English language

1 # Appendix H – Economic evidence tables

2

Study	Latimer 2021[20]			
Study details	**Population & interventions**	**Costs**	**Health outcomes**	**Cost effectiveness**
Economic analysis: CUA (health outcome: QALYs) **Study design:** Probabilistic model based on within-trial analysis of RCT included in the clinical review (Palmer 2020[38]). **Approach to analysis:** Markov model with 3-month cycles where all participants begin in the 'aphasia' health state. Two tunnel heath states for 'good response' (defined as a ≥10% increase in words correctly found on a naming test and/or a 0.5 increase on the Therapy Outcomes Measures activity scale.[1]) at 6 and 9 months from baseline. No new responses were assumed to occur after 12 months – participants	**Population:** Adults with aphasia who had had a stroke at least 4 months previously. **Cohort settings:** Start age: 65.4 years Male: 61% **Intervention 1:** Usual care (UC) **Intervention 2:** Computerised speech and language therapy (CSLT): Daily self-managed computerised word-finding therapy (StepByStep computer program) tailored by SLTs and supported by volunteers/SLT assistants for 6 months plus usual care. Participants practised computer exercises for 28 hours (mean).	**Total costs (mean per patient):** Intervention 1: £0 Intervention 2: £732.73 Intervention 3: £38.14 Incremental (2−1): £732.73 (95% CI: £674.23 to £798.05; p=NR) Incremental (3−1): £38.14 (95% CI: £34.94 to £41.50; p=NR) Incremental (2−3): £694.59 (95% CI: £636.46 to £760.09; p=NR) **Currency & cost year:** 2016/17 UK unit costs. **Cost components incorporated:** Hardware and software costs (computers,	**QALYs (mean per patient):** Intervention 1: 4.1992 Intervention 2: 4.2164 Intervention 3: 4.1991 Incremental (2−1): 0.0172 (95% CI: –0.05 to 0.10; p=NR) Incremental (3−1): –0.0001 (95% CI: –0.02 to 0.02; p=NR) Incremental (2−3): 0.0173 (95% CI: –0.05 to 0.10; p=NR)	**ICER (CSLT versus UC):** £42,686 per QALY gained (pa) 95% CI: NR **ICER (AC versus UC):** Dominated (AC had higher costs and lower QALYs) **ICER (CSLT versus AC):** £40,164 per QALY gained (pa) 95% CI: NR **Probability intervention is cost effective (£20K/£30K threshold):** • Usual care: 56%/45%, • CSLT: 22%/32%, • Attention control: 22%/22%. **Analysis of uncertainty:** Table 17 below describes the results from the base-case analysis and secondary analyses. Using different approaches to estimate **utility scores** did not change the

either remain in the 'good response (12 months and beyond), relapse to the 'Aphasia' health state or die. People in the 'Aphasia' health state at 12 months either remain in that health state or die. Utility weights are assigned to response and no response states to estimate QALYs. **Perspective:** UK NHS NHS and personal social services **Time horizon**: Lifetime **Treatment effect duration:**[(a)] 12-month utility data was extrapolated for remaining lifetime period. **Discounting:** Costs: 3.5%; Outcomes: 3.5%	**Intervention 3:** Activity/ attention control (AC); (completion of puzzles and receipt of telephone calls from a researcher for 6 months) plus usual care.	including StepByStep software licences, headphones, puzzle books); SLT training costs; SLT, SLTA and volunteer time costs and travel costs.		conclusions of the results but produced markedly different ICERs, ranging from £27,397 to £51,308 per QALY gained for CSLT compared to AC and £28,819 to £55,639 when compared to usual care alone. Subgroup analyses further demonstrated this reduction, as ICERs for participants with **mild and moderate** word finding difficulties at baseline were £22,371 and £21,262 per QALY gained respectively, for the comparison of CSLT with usual care alone. For CSLT compared to AC plus usual care, the ICERs were £30,911 for **mild** and £13,673 for **moderate** word finding difficulties. However, CSLT was more costly and less effective than usual care alone and AC plus usual care for participants with **severe** word finding difficulty, that is CSLT was dominated by both comparator groups. Halving speech and language therapist and assistant **costs** reduced the ICER for CSLT compared to usual care alone to £26,153 per QALY gained (£23,753 when compared to AC plus usual care). Alternative costing assumptions, including the inclusion of volunteer costs, did not change conclusions on cost-effectiveness.

Data sources
Health outcomes: Within-trial analysis of an RCT (Big CACTUS) included in the clinical review.[38] A pictorial version of EQ-5D-5L responses (adapted for this study to be accessible to patients with aphasia) was collected at each of the data collection time points (baseline and 6, 9 and 12 months) to estimate QALYs. Mortality rates for the first 5 years of the model were taken from Brønnum-Hansen (2001)[6], which included patients who had experienced a stroke ≥ 1 year previously. After 5 years, additional mortality was applied based on Office for National Statistics life tables 2014-2016[32]. **Quality-of-life weights:** Within-RCT analysis: EQ-5D-5L mapped to EQ-5D-3L (UK population valuation tariff). Utility scores were reduced over time according to multipliers

estimated by Ara and Brazier[2] **Cost sources:** Only direct intervention costs associated with computerised therapy and attention control were included. StepByStep software licences were taken from the StepByStep website[43]. Headsets and puzzle books were taken from the average cost that was purchased during the Big CACTUS trial. SLT (bands 5-7) and SLTA (band 3) cost per minute were taken from PSSRU 2017[11]. Volunteers were costed the same as a SLTA (included in the broader perspective only) for providing an equivalent service. Travel cost per mile was taken from Gov UK website[15].
Comments
Source of funding: The trial was funded by the National Institute for Health Research (NIHR) and the Tavistock Trust for Aphasia. **Limitations:** The lifetime model was based on an RCT with a short follow up (12 months) and focused on one piece of software which could affect the generalisability of the analysis. The health-related quality of life benefit associated with a good response to computerised therapy was small and uncertain, making it difficult to ascertain whether adding computerised therapy to usual care leads to a QALY gain compared to usual care alone. Accessible version of the EQ-5D-5L questionnaire is not yet validated, and although this allows utility (HRQoL) scores to be elicited directly from people with aphasia, whose language difficulties may make it difficult to complete standard EQ-5D-5L questionnaires. Only direct intervention costs were included as Big CACTUS did not collect data on wider resource use, due to the pilot study finding no important differences in indirect resource use associated with computerised therapy compared to usual care. **Other:** Analyses were developed as part of a Health technology assessment by Palmer 2020.[38]
Overall applicability:[(b)] Directly applicable **Overall quality:**[(c)] Potentially serious limitations

Abbreviations: 95% CI= 95% confidence interval; CUA= cost–utility analysis; da= deterministic analysis; EQ-5D= Euroqol 5 dimensions (scale: 0.0 [death] to 1.0 [full health], negative values mean worse than death); ICER= incremental cost-effectiveness ratio; NR= not reported; pa= probabilistic analysis; QALYs= quality-adjusted life years; SLT= Speech and Language therapist; SLTA = Speech and language therapy assistant.

(a) For studies where the time horizon is longer than the treatment duration, an assumption needs to be made about the continuation of the study effect. For example, does a difference in utility between groups during treatment continue beyond the end of treatment and if so for how long.

(b) Directly applicable / Partially applicable / Not applicable

(c) Minor limitations / Potentially serious limitations / Very serious limitations

Table 17: Cost-effectiveness results from base-case and secondary analyses from Latimer 2021 – computerised therapy plus usual care compared to usual care alone, and compared to attention control plus usual care

Analysis	Incremental cost (£) (95% credible interval)	Incremental QALYs	ICER (£ per QALY gained)
Comparator: usual care alone			
Base-case analysis	732.73 (674.23–798.05)	0.0172 (–0.05 to 0.10)	42,686
Using English EQ-5D-5L tariff	732.25 (673.19–797.84)	0.0132 (–0.04 to 0.09)	55,639
Using carer proxy EQ-5D-5L	733.06 (672.70–800.01)	0.0254 (–0.05 to 0.12)	28,819
Hernandez and Pudney EQ-5D-5L mapping[16]	732.96 (672.60–798.22)	0.0210 (–0.04 to 0.11)	34,921
SLT/SLTA costs halved	448.92 (411.50–495.12)	0.0172 (–0.05 to 0.10)	26,153
Comparator: attention control plus usual care[(a)]			
Base-case analysis	694.59 (636.46–760.09)	0.0173 (–0.05 to 0.10)	40,164
Using English EQ-5D-5L tariff	694.09 (634.95–759.75)	0.0135 (–0.04 to 0.09)	51,308
Using carer proxy EQ-5D-5L	694.88 (634.58–761.87)	0.0254 (–0.05 to 0.12)	27,397
Hernandez and Pudney EQ-5D-5L mapping[16]	694.78 (634.94–760.21)	0.0211 (–0.04 to 0.11)	32,835
SLT/SLTA costs halved[(b)]	410.78 (373.09–457.72)	0.0173 (–0.05 to 0.10)	23,753

Abbreviations: EQ-5D-5L= Euroqol 5 dimensions (5 levels) (scale: 0.0 [death] to 1.0 [full health]; SLT= Speech and language therapist; SLTA= Speech and language therapy assistant

(a) Computerised therapy plus usual care cost was £448.92 when SLT/SLTA costs are halved.
(b) Comparator cost was approximately £38 for attention control plus usual care group.

Study	Latimer 2013[21]			
Study details	**Population & interventions**	**Costs**	**Health outcomes**	**Cost effectiveness**
Economic analysis: CUA (health outcome: QALYs) **Study design:** Within-trial simple decision analytic model (feasibility cluster-RCT[39]) **Approach to analysis:** Three-state Markov model with month-long cycles, whereby participants could transition from their initial aphasia health state to a response state (defined as a >17% increase in proportion of words named correctly at 5 months), or to death. Patients in the response state could relapse to the aphasia state or die. Utility weights are assigned to response and no response states to estimate QALYs. **Perspective:** UK NHS	**Population:** Adults with a diagnosis of stroke and aphasia with word finding difficulties as one of the predominant features as assessed by the Comprehensive Aphasia Test (CAT) and the Object and Action Naming Battery. **Cohort settings:** Start age: 67.9 years Male: 62% **Intervention 1:** Usual stimulation. Participants received activities that provide general language stimulation as they had done previously including attendance at communication support groups and conversation, reading and writing activities that were a part of everyday life. **Intervention 2:** Computerised Speech and Language therapy using the StepByStep computer program	**Total costs (mean per patient):** Intervention 1: £18,687 Intervention 2: £19,124 Incremental (2−1): £436.87 (95% CI: NR; p=NR) **Currency & cost year:** 2010 UK unit costs. **Cost components incorporated:** Intervention costs included the cost of computers (£495.99), Step-by-Step software (£250), microphones (£7.50) and the cost of SLT training and support, which including setting up and assisting patients with the computer program. Resource use included GP, nurse, and other health care professional visits and consultations, as well as hospital admissions,	**QALYs (mean per patient):** Intervention 1: 3.07 Intervention 2: 3.22 Incremental (2−1): 0.14 (95% CI: NR; p=NR)	**ICER (Intervention 2 versus Intervention 1):** £3,058 per QALY gained (pa) 95% CI: NR **Probability Intervention 2 is cost effective (£20K threshold):** 75.8% **Analysis of uncertainty:** Scenario analyses showed that the results of the model were sensitive to the utility gain and relapse rate parameters. For instance, if the utility gain associated with a good response to treatment was 0.01 or less (seven times less than the mean observed in the CACTUS trial, but well within the 95 percent CI (-0.15 to 0.29)), the ICER would be greater than £20,000. Scenario analysis results showed that the ICER would also be higher than £20,000 if the release rate was greater than approximately 30% per month (from a base case relapse rate of 0.08%). The combined effect of these two parameters had a much larger impact however, as applying a 50% decrease to the base case utility gain (0.035 down from 0.07) and increasing the relapse rate to 30% per month after month 5, the ICER increases to £39,491.

NHS and personal social services **Time horizon**: Lifetime **Treatment effect duration:**[(a)] 5-month utility data was extrapolated to lifetime with 0.08% monthly relapse rate applied. **Discounting:** Costs: 3.5%; Outcomes: 3.5%	(method of therapy: word finding and reading) Participants used their own computer (35%) or a loaned laptop computer (65%). Independent practice was advised for at least 20 minutes, 3 days a week, for 5 months (25 hours of total practice total).	appointments, and prescribed medication.		

Data sources

Health outcomes: Within-trial analysis of a pilot feasibility RCT (CACTUS) included in the clinical review.[39] A pictorial version of EQ-5D-3L responses (adapted for this study to be accessible to patients with aphasia) was collected at baseline, 5- and 8-months follow-up were used to estimate QALYs. Mortality was incorporated into the model using 2007-2009 lifetables for England and Wales[31] adjusted to reflect the increased mortality rates in people who have had a stroke. Standardized mortality ratios (SMRs) for all-cause mortality after stroke compared with age/sex adjusted rates for the general population reported by Bronnum-Hansen et al. (2001)[6] were used. The relapse rate was estimated by subtracting the proportion of patients who maintained a ≥17% increase in the percentage of treated words named correctly at 8 months, from the proportion who could demonstrate that response at 5 months. **Quality-of-life weights:** Within-RCT analysis using EQ-5D-3L (UK population valuation tariff). Utility scores were reduced over time according to multipliers estimated by Ara and Brazier[2] **Cost sources:** Within-trial analysis of resource use measured using patient and carer diaries collected at 5 months post-randomisation. After 5 months, resource use costs were assumed to be the same for both groups by applying 5-month resource use estimates collected from the control group. UK National Unit costs applied.

Comments

Source of funding: The trial was funded by the National Institute for Health Research (NIHR), Stroke and Telehealth themes of the South Yorkshire Collaboration for leadership in applied health research and care (CLAHRC). The study also received support from North of Tyne Primary Care Trust. **Limitations:** The lifetime model was based on an RCT with a short follow up (8 months) and focused on one piece of software which could affect the generalisability of the analysis. Resource use was not estimated from a systematic review but from self-reported questionnaire. The utility of non-responders was assumed to be equal for the intervention group and control group, which overlooks the possibility that the utility for non-responders in the intervention group could be lower than the utility in the control group. The validity of the definition of a ‘good response’ is uncertain, as it was arbitrarily defined as those who demonstrated a word-finding improvement that was better than the average increase observed in the experimental group. The accessible version of the EQ-5D-5L questionnaire is not yet validated, although this allows for utility (HRQoL) scores to be elicited directly from people with aphasia, whose language difficulties may make it difficult to complete standard EQ-5D-5L questionnaires. Finally, it should be noted that the sample size of the CACTUS trial was small (n=34) and aimed to assess the feasibility of a rigorous RCT of a self-managed computer therapy. Therefore, it cannot be expected to provide conclusive cost-effectiveness results.

Overall applicability:[b] Partially applicable	**Overall quality:**[c] Potentially serious limitations

Abbreviations; 95% CI= 95% confidence interval; CUA= cost–utility analysis; da= deterministic analysis; EQ-5D= Euroqol 5 dimensions (scale: 0.0 [death] to 1.0 [full health], negative values mean worse than death); ICER= incremental cost-effectiveness ratio; NR= not reported; pa= probabilistic analysis; QALYs= quality-adjusted life years

(a) For studies where the time horizon is longer than the treatment duration, an assumption needs to be made about the continuation of the study effect. For example, does a difference in utility between groups during treatment continue beyond the end of treatment and if so for how long.

(b) Directly applicable / Partially applicable / Not applicable

(c) Minor limitations / Potentially serious limitations / Very serious limitations

Appendix I – Health economic model

Modelling was not prioritised for this question.

1

2 # Appendix J – Excluded studies

3 ## Clinical studies

4 **Table 18: Studies excluded from the clinical review**

Study	Code [Reason]
Agostini, M., Garzon, M., Benavides-Varela, S. et al. (2014) Telerehabilitation in poststroke anomia. BioMed Research International 2014 (no pagination)	- Data not reported in an extractable format or a format that can be analysed *Reported F and p values only with no values that can be used to calculate mean and SD values*
Brady, Mc, Kelly, H, Godwin, J et al. (2016) Speech and language therapy for aphasia following stroke. Cochrane Database of Systematic Reviews	- Systematic review used as source of primary studies *Cochrane review investigating speech and language therapy that is not just computer based. References checked.*
Braley, M, De, Oliveira E, Munsell, M et al. (2020) A Phase II Randomized, Virtual, Clinical Trial of Speech Therapy App for Speech, Language, and Cognitive Intervention in Stroke. Archives of Physical Medicine and Rehabilitation 101(11): e62	- Conference abstract
Cacciante, L., Kiper, P., Garzon, M. et al. (2021) Telerehabilitation for people with aphasia: A systematic review and meta-analysis. Journal of Communication Disorders 92: 106111	- Systematic review used as source of primary studies
Chiaramonte, R.; Pavone, P.; Vecchio, M. (2020) Speech rehabilitation in dysarthria after stroke: a systematic review of the studies. European journal of physical & rehabilitation medicine. 56(5): 547-562	- Study does not contain an intervention relevant to this review protocol *Included computer based and non-computer based speech and language therapy. References checked.*
Chiaramonte, R. and Vecchio, M. (2021) Dysarthria and stroke. The effectiveness of speech rehabilitation. A systematic review and meta-analysis of the studies. European journal of physical & rehabilitation medicine. 57(1): 24-43	- Duplicate reference
Choe, Y. K., Azuma, T., Mathy, P. et al. (2007) The effect of home computer practice on naming in individuals with nonfluent aphasia and	- Non-randomised study that does not account for confounding factors

Study	Code [Reason]
verbal apraxia. Journal of Medical Speech-Language Pathology 15(4): 407-421	
Crerar, M. A. and Ellis, A. (1995) Computer-based therapy for aphasia: towards second generation clinical tools. The treatment of aphasia: from theory to practice.: 222-250	- Study design not relevant to this review protocol
Cross, E. (2014) Cost effectiveness of Aphasia Computer Treatment versus Usual Stimulation or attention control long term post stroke: a randomised trial.	- Clinical trial registry data only
De Cock, E. (2019) Tablet-based aphasia therapy in the chronic phase.	- Clinical trial registry data only
Dial, H. R., Hinshelwood, H. A., Grasso, S. M. et al. (2019) Investigating the utility of teletherapy in individuals with primary progressive aphasia. Clinical Interventions In Aging 14: 453-471	- Population not relevant to this review protocol *Primary progressive aphasia rather than stroke-induced aphasia*
Fink, R. B., Brecher, A., Sobel, P. et al. (2005) Computer-assisted treatment of word retrieval deficits in aphasia. Aphasiology 19(10-11): 943-954	- Study design not relevant to this review protocol *Case series*
Fuentes, B., de la Fuente-Gomez, L., Sempere-Iborra, C. et al. (2022) DUbbing Language-therapy CINEma-based in Aphasia post-Stroke (DULCINEA): study protocol for a randomized crossover pilot trial. Trials [Electronic Resource] 23(1): 21	- Protocol only
Giachero, A., Calati, M., Pia, L. et al. (2020) Conversational Therapy through Semi-Immersive Virtual Reality Environments for Language Recovery and Psychological Well-Being in Post Stroke Aphasia. Behavioural Neurology 2020: 2846046	- Data not reported in an extractable format or a format that can be analysed *No values provided that could be used consistently to calculate standard deviations for all groups*
Goodenough-Trepagnier, C. (1990) Early intervention with globally aphasic stroke patients using a computerized visual communication technique. Journal of rehabilitation research and development 28(1): 369-370	- Conference abstract
Guo, Y. E., Togher, L., Power, E. et al. (2017) Assessment of Aphasia Across the International Classification of Functioning, Disability and Health Using an iPad-Based Application. Telemedicine Journal & E-Health 23(4): 313-326	- Study does not contain an intervention relevant to this review protocol *Computer based program to assess aphasia rather than conduct rehabilitation therapy*

Study	Code [Reason]
Harrison, M. (2019) Evaluating the intervention fidelity of self-managed computer therapy for aphasia post-stroke. Evaluating the intervention fidelity of self-managed computer therapy for aphasia post-stroke	- Thesis only *Discusses a trial that has been included in the review (Big CACTUS trial)*
Harvey, S.; Baird, A.; Meltzer, J. A. (2015) Evaluation of TeleRehab effectiveness for post-stroke communication disorders. International journal of stroke 10(suppl4): 83	- Conference abstract
Huang, L., Chen, S. K., Xu, S. et al. (2021) Augmentative and alternative communication intervention for in-patient individuals with post-stroke aphasia: study protocol of a parallel-group, pragmatic randomized controlled trial. Trials [Electronic Resource] 22(1): 837	- Study does not contain an intervention relevant to this review protocol *Not computer based speech and language therapy*
Kim, E. S., Laird, L., Wilson, C. et al. (2021) Implementation and Effects of an Information Technology-Based Intervention to Support Speech and Language Therapy Among Stroke Patients With Aphasia: Protocol for a Virtual Randomized Controlled Trial. JMIR Research Protocols 10(7): e30621	- Protocol only
Laganaro, M.; Di Pietro, M.; Schnider, A. (2006) Computerised treatment of anomia in acute aphasia: treatment intensity and training size. Neuropsychological rehabilitation 16(6): 630-640	- Population not relevant to this review protocol *3 out of 8 participants had a traumatic brain injury instead of a stroke*
Lee, J., Fowler, R., Rodney, D. et al. (2010) IMITATE: An intensive computer-based treatment for aphasia based on action observation and imitation. Aphasiology 24(4): 449-465	- Protocol only
Lee, Jaime B. and Cherney, Leora R. (2016) Computer-Based Treatments for Aphasia: Advancing Clinical Practice and Research. Perspectives of the ASHA Special Interest Groups 1(2): 5-17	- Systematic review used as source of primary studies *Included single arm trials*
Palmer, R.; Enderby, P.; Paterson, G. (2013) Using computers to enable self-management of aphasia therapy exercises for word finding: the patient and carer perspective. International Journal of Language & Communication Disorders 48(5): 508-21	- Study design not relevant to this review protocol *Qualitative study*

Study	Code [Reason]
Penaloza, C., Scimeca, M., Gaona, A. et al. (2021) Telerehabilitation for Word Retrieval Deficits in Bilinguals With Aphasia: Effectiveness and Reliability as Compared to In-person Language Therapy. Frontiers in Neurology 12 (no pagination)	- Comparator in study does not match that specified in this review protocol *The study is a retrospective analysis of a trial randomised to whether someone receives therapy in their language of choice or not.*
Repetto, C., Paolillo, M. P., Tuena, C. et al. (2021) Innovative technology-based interventions in aphasia rehabilitation: a systematic review. Aphasiology 35(12): 1623-1646	- Systematic review used as source of primary studies *Includes studies with no control group*
Stachowiak, F. J. (1994) Computers in aphasia rehabilitation. Brain injury and neuropsychological rehabilitation.: 133-160	- Data not reported in an extractable format or a format that can be analysed *Does not report data that could be used to calculate standard deviations*
Stark, B. C. and Warburton, E. A. (2018) Improved language in chronic aphasia after self-delivered iPad speech therapy. Neuropsychological rehabilitation 28(5): 818-831	- Crossover trial that does not report outcomes for each phase
Stark, B. C. and Warburton, E. A. (2015) "CATCH study" - computerised aphasia therapy in chronic aphasia: using self-administered iPad-delivered speech therapy to explore language improvements in post-stroke chronic expressive aphasia. Cerebrovascular diseases (Basel, Switzerland) 39(suppl2): 119	- Conference abstract
Thunstedt, D. C., Young, P., Kupper, C. et al. (2020) Follow-Up in Aphasia Caused by Acute Stroke in a Prospective, Randomized, Clinical, and Experimental Controlled Noninvasive Study With an iPad-Based App (Neolexon R): Study Protocol of the Lexi Study. Frontiers in neurology [electronic resource]. 11: 294	- Protocol only
Thunstedt, D. C., Young, P., Kupper, C. et al. (2020) Follow-up in aphasia caused by acute stroke in a prospective, randomized, clinical, and experimental controlled noninvasive study with an ipad-based app Neolexon: Study protocol of the lexi study. Frontiers in Neurology 11 (no pagination)	- Duplicate reference
Uslu, A. S., Gerber, S. M., Schmidt, N. et al. (2020) Investigating a new tablet-based telerehabilitation app in patients with aphasia: a	- Protocol only

Study	Code [Reason]
randomised, controlled, evaluator-blinded, multicentre trial protocol. BMJ Open 10(11): e037702	
West, C, Hesketh, A, Vail, A et al. (2005) Interventions for apraxia of speech following stroke. Cochrane Database of Systematic Reviews	- Systematic review used as source of primary studies *Cochrane review. Only includes people with aphasia of speech. Included no studies.*

Health Economic studies

Published health economic studies that met the inclusion criteria (relevant population, comparators, economic study design, published 2006 or later and not from non-OECD country or USA) but that were excluded following appraisal of applicability and methodological quality are listed below. See the health economic protocol for more details.

Table 19: Studies excluded from the health economic review

Reference	Reason for exclusion
None.	

Appendix K – Research recommendations – full details

K.1 Research recommendation

Research recommendation

What is the clinical and cost-effectiveness of using computer-based tools to treat speech (dysarthria) and all domains of language (aphasia) for people with communication difficulties after stroke?

K.1.1 Why this is important

Approximately one third of stroke survivors experience some form of speech and language difficulty following a stroke and this can greatly impact their health-related quality of life. Speech and language therapy is provided by speech and language therapists in hospitals or community and can exist in various formats. Since the COVID-19 pandemic there has been an increase in the use of computer-based tools to deliver speech and language therapy remotely and to promote self-practice and increase the dose of therapy. Delivering higher intensity models of care for stroke rehabilitation is an initiative in the NHS long term plan. Therefore, the use of computer-based tools as an adjunct to in-person speech and language therapy can offer an effective way of increasing therapy dose with less resource impact. Evidence from the clinical review showed that use of computer-based tools was effective but only for improving naming when interventions focused on or included word finding tasks as a component. Therefore, further research is required to determine if computer-based tools designed to treat speech and designed to treat all domains of language (rather than just one domain such as naming) are clinically and cost effective.

K.1.2 Rationale for research recommendation

Importance to 'patients' or the population	Approximately one third of stroke survivors experience some form of speech and language difficulty following a stroke and this can greatly impact health related quality of life. Since the COVID-19 pandemic there has been an increase in the use of computer-based tools to deliver speech and language therapy remotely. Computer-based tools for speech and language therapy may allow for a higher intensity of therapy to be delivered which has been highlighted as important to people after stroke.
Relevance to NICE guidance	Computer-based tools are being increasingly used to deliver speech and language therapy. This review identified that only interventions focused on word finding were effective for stroke survivors and health economic evidence was mixed. Use of computer-based tools may be a way to increase therapy dose. Use of computer applications and programmes to deliver therapy is becoming more common place in stroke rehabilitation in general. Further research including economic analysis is important to answer the original review question.
Relevance to the NHS	Delivering higher intensity models of care for stroke rehabilitation is an initiative in the NHS long term plan. Therefore, the use of computer-based tools as an adjunct to in person speech

	and language therapy can offer an effective way of increasing therapy dose with less resource impact for the NHS.
National priorities	Delivering higher intensity models of care for stroke rehabilitation is an initiative in the NHS long term plan and this form of delivery is a way to increase dose of therapy.
Current evidence base	This review reported that speech and language therapy delivered through computer-based tools is effective for improving naming tasks when interventions focused on or included word finding as a component. There was limited evidence investigating use of computer-based tools for all domains of language and for speech. Additionally, cost effectiveness data was mixed. Further research is required to establish if any other forms of computer-based tools are effective in this emerging field.
Equality considerations	No specific equality considerations were identified. The committee noted that in general throughout the guideline, people with cognitive difficulties, older people and people who have had a previous stroke or transient ischaemic attack were excluded from trials but are people that the guideline is for. Therefore, research should aim to include these people where possible.

K.12 Modified PICO table

Population	Inclusion: Adults (age ≥16 years) who have had a first or recurrent stroke (including people after subarachnoid haemorrhage). Stratify by (or separate trials for): • People who have dysarthria • People who have aphasia Exclusion: • Children (age <16 years) • People who have had a transient ischaemic attack
Intervention	• Computer-based tools for speech and language therapy (to deliver therapy). These can include: ○ Word finding therapy ○ Reading therapy ○ Writing therapy ○ Comprehension therapy ○ Expressive language/communication ○ Articulation therapy ○ Pitch and volume/melodic therapies ○ Combination of the above

Comparator	Speech and language therapy without computer based tools (usual care)
Outcome	Person/participant generic health-related quality of life Carer generic health-related quality of life Communication (including: overall language ability, naming, auditory comprehension, reading, expressive language and functional communication) Communication related quality of life Psychological distress (depression, anxiety and distress) Discontinuation (dichotomous outcome)
Study design	Randomised controlled trials
Timeframe	6 months
Additional information	Subgroup analyses: • Severity (NIHSS mild, moderate, severe, very severe) • Severity of communication difficulty: (mild, moderate, severe, very severe)