CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Virtual Stroke Rehabilitation

7th Edition, Interim Consensus Statement 2022*

This interim Consensus Statement was undertaken to address the pandemic-related shift to virtual care. This consensus statement will be fully integrated into the Rehabilitation and Recovery following Stroke module when that module undergoes full review in the CSBPR update process.

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on Behalf of the Canadian Stroke Best Practice Recommendations
Virtual Stroke Rehabilitation Writing Group and in collaboration with the Canadian Partnership for Stroke Recovery and the Canadian Stroke Consortium

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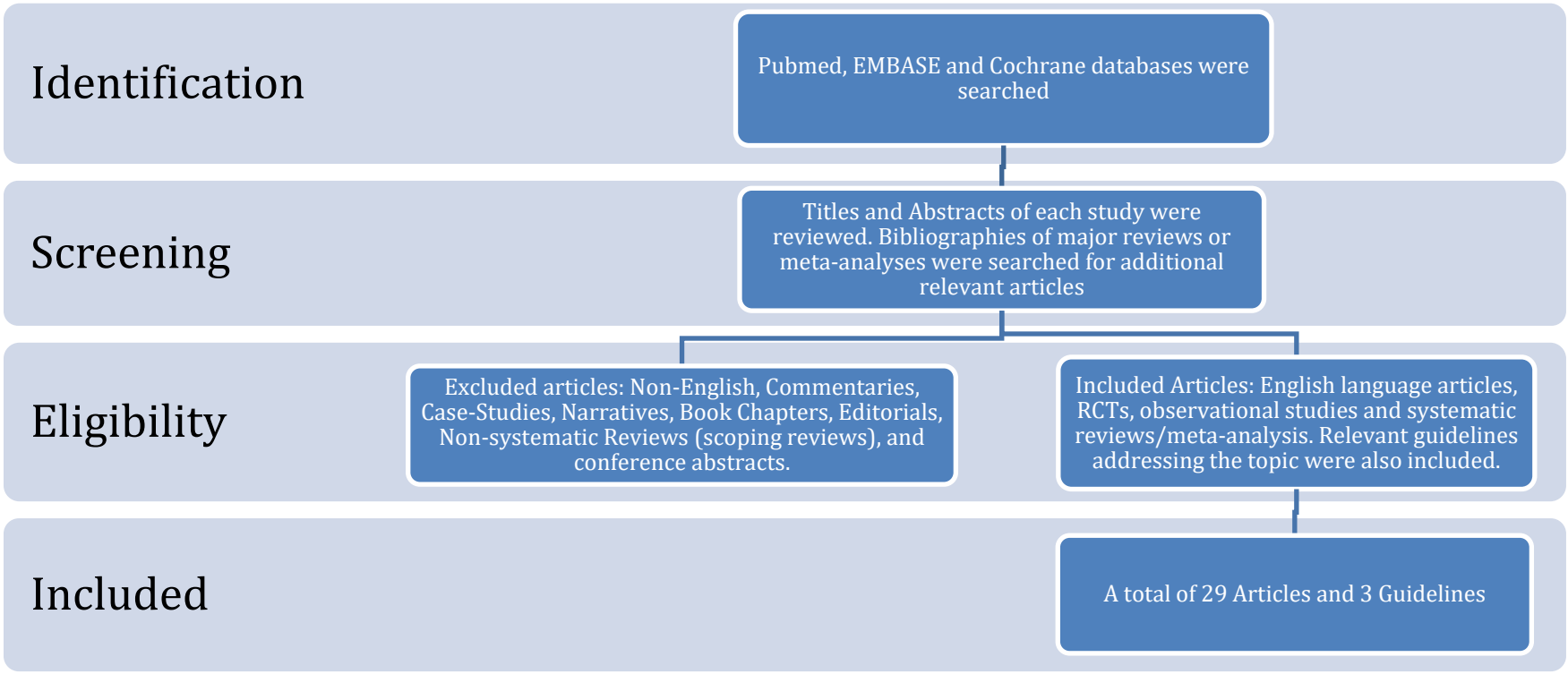
Search Strategy



Pubmed, EMBASE and Cochrane databases were search using the terms telerehabilitation, stroke, aphasia, virtual care, remote care and telemedicine. Titles and abstract of each article were reviewed for relevance. Bibliographies were reviewed to find additional relevant articles. Articles were excluded if they were: non-English, commentaries, case-studies, narrative, book chapters, editorials, non-systematic review, or conference abstracts. Additional searches for relevant best practice guidelines were completed and included in a separate section of the review.

Published Guidelines

Guideline	Recommendations
Clinical Guidelines for Stroke Management 2017. Melbourne (Australia): National Stroke Foundation. Section 4. Rehabilitation	**Weak recommendation** Telehealth services may be used as an alternative approach to delivering rehabilitation, especially for patients who cannot access specialist rehabilitation in the community. It may also be used as an adjunct to in-person therapy. Delivering of specific interventions via telehealth should only be considered for those that have demonstrated benefits. (Laver et al 2020) DRAFT RECOMMENDATION AUGUST 2021
Intercollegiate Stroke Working Party. National clinical guideline for stroke, 5th edition. National Institute for Health and Clinical Excellence London: Royal College of Physicians, 2016.	None for rehabilitation
Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC, Deruyter F, Eng JJ, Fisher B, Harvey RL, Lang CE, MacKay-Lyons M, Ottenbacher KJ, Pugh S, Reeves MJ, Richards LG, Stiers W, Zorowitz RD; on behalf of the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Quality of Care and Outcomes Research. **Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart**	**Recommendations: Assessment of Communication Impairment** Telerehabilitation is reasonable when face-to-face assessment is impossible or impractical. Class IIa, Level A **Recommendations: Motor Speech Disorders: Dysarthria and Apraxia of Speech** Telerehabilitation is reasonable when face-to-face assessment is impossible or impractical. Class IIa, Level C

Guideline	Recommendations
Association/American Stroke Association. ***Stroke* 2016;47:e98–e169**	
Schwamm LH, Holloway RG, Amarenco P, Audebert HJ, Bakas T, Chumbler NR, Handschu R, Jauch EC, Knight WA IV, Levine SR, Mayberg M, Meyer BC, Meyers PM, Skalabrin E, Wechsler LR; on behalf of the American Heart Association Stroke Council and the Interdisciplinary Council on Peripheral Vascular Disease. **A review of the evidence for the use of telemedicine within stroke systems of care: a scientific statement from the American Heart Association/American Stroke Association.** ***Stroke* 2009;40:2616 –2634.**	**Class I recommendations** 8. Assessment of occupational, physical, or speech disability in stroke patients by allied health professionals via high-quality videoconferencing systems using specific standardized assessments is recommended when in-person assessment is impractical, the standardized rating instruments have been validated for high-quality videoconferencing use, and administration is by trained personnel using a structured interview (Class I, Level of Evidence B). 9. Telephonic assessment for measuring functional disability after stroke is recommended when in-person assessment is impractical, the standardized rating instruments have been validated for telephonic use, and administration is by trained personnel using a structured interview (Class I, Level of Evidence B). **Class II recommendations** 5. Delivery of occupational or physical therapy to stroke patients by allied health professionals via high-quality videoconferencing systems is reasonable when in-person assessment is impractical (Class IIa, Level of Evidence B).

Evidence Tables

Telemedicine for Stroke Rehabilitation

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Systematic reviews & meta-analyses					
Laver et al. 2020 **Australia** **Cochrane review**	Items where ≥50% of the trials were considered to have low risk of bias included random sequence generation, concealed allocation, blinding of outcome assessment and incomplete outcome data. 70% of trials were considered to be at high or unclear risk of bias for selective reporting	22 RCTs (n=1937) including patients with all stroke types, including SAH at all levels of severity and at all stages stroke recovery. 13 studies excluded participants with significant cognitive impairment and 4 excluded those without a caregiver. 8 trials recruited patients in the acute stage of stroke, following discharge from hospital while the remainder recruited patients in the subacute and chronic stage.	Trials compared telerehabilitation (services delivered using information and communication technologies) programs composed of ≥1 session, compared with in-person or no rehabilitation and trials comparing 2 different types of telerehabilitation. All interventions were delivered in patient's homes, or, in one case, a long-term care facility. 8 studies aimed to enhance care and well-being after discharge through interventions that included goal setting, education about secondary prevention, family therapy, and case management. Studies used customised computer-based training programmes to improve physical function, 4 studies used customised	**Primary outcome:** Independence in ADL **Secondary outcome:** Self-care & domestic life, mobility, balance, participant satisfaction, HR QoL, depression, upper-limb function, cognitive function, functional communication, cost-effectiveness	14 studies were used in pooled analyses, which included 2 pre-planned comparisons *In person rehabilitation vs. telerehabilitation* At the end of the intervention there was no difference between groups in mean ADL function (MD=0.59, 95% CI -5.50 to 6.68). Results from 2 trials included (n=75). There were no significant differences between groups in measures of balance (MD= 0.48, 95% CI -1.36 to 2.32, 3 trials included, n=106) or measures of upper extremity function (MD=1.23, 95% CI -2.17 to 4.64, 3 trials included, n=170) *Usual care vs. telerehabilitation* At the end of the intervention there were no differences between groups on any of the outcomes assessed (Independence in ADL, mobility, self-reported health-related quality of life, depression or upper-limb function.

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			telerehabilitation systems and communication between the participant and the therapist one study involved exercises delivered remotely plus electrical stimulation		
Knepley et al. 2021 **USA** **Systematic review**	PEDro scores ranged from 2-8.	34 studies (n= 1,025 patients), of which 14 did not include a control group. Participants were recovering from stroke.	Trials compared rehabilitation therapy delivered through telerehabilitation (TR) with conventional in person outpatient rehabilitation, no rehabilitation or other TR therapies. Interventions were related to motor retraining (n=12), virtual reality (n=8), speech therapy (n=7), robot assisted (n=4), community-based exercises (n=2), goal setting (n=1)	**Primary outcome:** None stated a priori Common outcomes included The Wolf Motor Function test, the Fugl-Meyer assessment, FIM, Western Aphasia Battery and satisfaction	In all 34 studies, there was improvement from baseline after TR therapy. Among the 16 studies with non-TR control interventions, 9 observed equivalent outcomes between TR and non-TR, and 7 observed better outcomes after TR, although many of these had mixed results. Two studies reported superior patient satisfaction or anxiety scores in patients receiving TR compared with those receiving traditional clinical therapy, while 2 reported no significant differences between groups.
Appleby et al. 2019 **Australia** **Systematic review**	Using the modified McMaster Critical Appraisal Tool, scores ranged from 7–12 out of 14	13 RCTs including participants who had suffered a stroke.	Trials compared telerehabilitation therapies designed to improve function +/ usual care compared with usual care. 8 studies used videoconferencing for instruction and communication, 3 studies used 3-D motion equipment and software to generate virtual representations	**Primary outcomes:** Motor function (upper and lower extremity) and ADL	Motor function was assessed in 11 studies. Of 10 studies that reported between group differences, none reported significant between group differences. There were significant within group improvements in each group in 8 studies. Three studies investigated ADLs. Of these, none reported significant between group differences; all reported within group improvements.

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			of participants' movements and one study combined videoconferencing with biofeedback and physiological data. Four studies had each session supervised by a telerehabilitation system, 9 studies included partial supervision through telerehabilitation systems and physical assistance.		
Nordio et al. 2018 **Italy** **Systematic review**	Performance and detection biases were detected	One RCT (n=79) including persons with oropharyngeal squamous cell carcinoma for whom (chemo)radiotherapy was planned. Mean age was 58.7 years, 89% were men.	Patient adherence to a prophylactic swallowing therapy protocol was assessed by randomizing patients 1:1:1 to receive the "Pharyngocise" protocol via the 3 different service-delivery models: (1) clinician-directed face-to-face therapy, (2) technology-assisted therapy using the *SwallowIT* therapy application (an asynchronous telepractice system) and (3) independent patient-directed therapy.	**Primary outcome:** Adherence to the protocol over 6 weeks, calculated as the percentage of prescribed exercise completed.	Overall, there was a significant decline in adherence over time, with no difference between groups. Of the 71 participants who completed the study, overall adherence was 27%. Adherence during weeks 1-3: There was a significant difference in adherence among groups. Mean adherence was 43% in the clinician directed group, 36% in the *SwallowIT* group and 26% in the patient-directed group. In post hoc comparison, there was significantly greater adherence with the clinician-directed compared with the patient-directed group (p=0.014). Adherence during weeks 4-6: There was no significant difference in adherence among groups. Mean adherence was 22% in the clinician directed group, 22% in the *SwallowIT* group and 15% in the patient-directed group.
Sarfo et al. 2018 **USA**	NA	22 studies that included persons recovering from stroke.	Studies compared rehabilitation interventions and assessments conducted using telemedicine,	**Primary outcome:** Motor function, depression, higher cortical dysfunction	Among 18 studies that focused on motor deficits, 11 assessed interventions on mobility or movement limitations, 6 focused on upper limb interventions, and 1 on ankle disability. In general, improvements in motor function were reported in all studies in both the

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Systematic review			telecommunication media, and intervention programs including phone, videoconferencing, tele-rehabilitation system, robot assisted rehabilitation, and virtual and augmented reality therapy compared with usual or no care. Minimum duration of therapy was 2 weeks		intervention and control groups receiving tele-rehabilitation, while there were significantly greater improvements reported in the intervention group in 7/18 studies. Two studies assessed tele-rehabilitation intervention for aphasia and visuo-spatial neglect. Both studies reported feasibility of the interventions with no significant between group differences. Two studies assessed tele-rehabilitation on resolution of depression among stroke survivors or caregivers. Participants in both groups improved over time, with no significant between group differences.
Tchero et al. 2018 **France** **Systematic review & meta-analysis**	All trials had low risk of bias for their methods of random sequence generation, blinding of outcome assessors, and reducing the risk of attrition bias, except for 3 trials in each domain.	15 RCTs including 1,339 patients recovering from stroke.	Trials compared different models of telerehabilitation vs. standard rehabilitation care or a home-based exercise program. The follow-up period ranged between 4 and 24 weeks.	**Primary outcomes:** ADL, balance	There was no significant difference in Barthel Index scores between groups (SMD= –0.05, 95% CI –0.18 to 0.08, p=.47. Results from 6 trials included). There was no significant difference in Berg Balance Scale scores between groups (SMD= –0.04, 95% CI –0.34 to 026, p=.78. Results from 4 trials included). There was no significant difference in Fugl-Meyer Upper Extremity scores between groups (SMD= 0.5, 95% CI –0.19 to 1.09, p=.10. Results from 2 trials included). There was no significant difference in Action Research Arm Test scores between groups (SMD= -0.06, 95% CI –0.46 to 0.33, p=.75. Results from 2 trials included). There was no significant difference in Stroke Impact Scale (mobility subscale) scores between groups (SMD= 0.18, 95% CI –0.13 to 0.48, p=0.26).
Chen et al. 2015 **China** **Systematic review & meta-analysis**	NA	7 RCTs that included patients ≥18 years who had sustained a stroke and received rehab therapies through telemedicine systems for a minimum of 4	In 6 trials, virtual reality-based training was used to provide rehab therapies, while therapies or support were provided by either the phone or the	**Primary outcome:** Measures of disability or ADL assessment **Secondary outcomes:**	There was no significant difference in mean Barthel Index scores between groups (SMD=-0.05, 95% CI -0.24-0.13, p=0.57. Results from 6 trials included). There was no significant difference in mean Berg Balance Scale scores between groups (SMD=-0.17,

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		weeks in duration. Mean ages of patients ranged from 53-75 years.	internet in 2 trials. The control group in most trials was usual or standard care.	Motor function, cognitive assessments, health-related QoL	95% CI -0.70-0.37, p=0.54. Results from 2 trials included). There was no significant difference in mean Fugl-Meyer (Upper Extremity) scores between groups (SMD=0.05, 95% CI -0.09-1.09, p=0.10. Results from 2 trials included).
Studies					
Asano et al. 2021 **Singapore** **RCT** ***The Singapore Tele-technology Aided Rehabilitation in Stroke (STARS)***	CA: ☒ Blinding patient: ☒ assessor: ☑ ITT: ☒	124 persons aged ≥40 years who had suffered a first or recurrent stroke within the previous 4 weeks, who were living in the community before the stroke and expected to be discharged home. Mean age was 64 years, 52% were men.	Participants were randomized to receive 3 months of physiotherapy (PT) and occupational therapy (OT) via a tele-rehabilitation system that includes exercise 5-days-a-week using an iPad-based system that allows recording of daily exercise with video and sensor data and weekly videoconferencing with tele-therapists after data review vs. standard PT and OT.	**Primary outcome:** Late-Life Function and Disability Instrument (LLFDI) **Secondary outcomes:** The timed 5-metre walk test, 2-minute walking distance, BI, Activities-Specific Balance (ABC) scale and the EuroQoL (EQ-5D) Assessments were completed at baseline and at the end of treatment.	11 participants from the tele-rehab group and 15 from the control group withdrew prior to the 3-month assessment. While persons in both groups had improved, there was no significant difference in the adjusted mean change score between groups for either the LLFDI-total frequency score (-0.56, 95% CI -4.22 to 3.09) or LLFDI-total limitation score (1.08, 95% CI -7.15 to 9.31). There were no significant differences in the adjusted mean change score between groups for any of the secondary outcomes
Yang et al. 2021 **Canada** **Prospective study**	NA	9 adults with difficulty using their affected upper extremity associated with a remote stroke, who were living in the community. Mean age was 66 years, 4 were women. Mean time since stroke was 66 months.	Two iterations of the Graded Repetitive Arm Supplementary Program (GRASP) were delivered over 10 weeks by videoconferencing (Zoom) The program was evaluated using the Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) framework	**Primary outcomes:** Arm Capacity and Movement test (ArmCAM), The Rating of Everyday Arm-use in the Community and Home Scale (REACH) and the Stroke Impact Scale Hand subscore (SIS-Hand) Assessments were conducted at baseline, end of treatment and 6-month follow-up	Mean baseline, post-test and follow-up scores (total possible score) ArmCAM (/30): 18.67, 20.00, 19.78 REACH (0–5): 3.00, 3.56, 3.44 SIS-Hand (/100): 35.56, 47.56, 50.22 SIS-Hand Recovery (/100): 46.67, 60.56, 58.78 There were significant changes in mean scores across time for all outcomes. Effect sizes for changes from baseline to post test ranged from 0.45 to 0.60. Effect sizes for changes from baseline to end of follow-up ranged from 0.47 to 0.63.

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					All 4 staff and instructors reported the virtual format of the GRASP program generally worked very well, although some challenges were noted. Sometimes it was difficult to observe participants due to the web camera set-up and background noise could be distracting.
Chen et al. 2020 **China** **RCT**	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☑	52 patients aged 30-85 years with first-ever stroke that occurred 1-3 weeks previously, with residual hemiplegia and NIHSS scores between 2 and 20. Mean age was 62 years, 50% were men. Median baseline NIHSS was 5. Mean time since stroke was 14 days.	Patients were randomized 1:1 to a home-based motor training telerehabilitation (TR) group, using live videoconferencing, or a conventional outpatient rehabilitation (CR) group for 12 weeks. All patients received OT, PT and electromyography-triggered neuromuscular stimulation with a target of 10 training sessions per week, each 60 minutes in length.	**Primary outcomes:** Fugl-Meyer assessment (FMA) for upper and lower extremities and the modified Barthel index (MBI) **Secondary outcomes:** Functional connectivity between the bilateral M1 areas; the gray matter volume (GMV) of the bilateral M1 areas; and white matter (WM) integrity of the bilateral CSTs measured by fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD) and radial diffusivity (RD).	Mean baseline FMA in the TR group was 71.88, with a mean change of 11.12 at the end of treatment. Mean baseline FMA in the CR group was 71.65, with a mean change of 5.31 at the end of treatment. The mean difference in change was 5.81 (95% CI 0.56 to 6.97). TR was both non-inferior (p=0.003) and superior to CR (p=0.011). Mean baseline MBI in the TR group was 70, with a mean change of 12.7 at the end of treatment. Mean baseline MBI in the CR group was 77.5, with a mean change of 7.1 at the end of treatment. The mean difference in change was 5.58 (95% CI 0.50 to 10.35). TR was non-inferior to CR (p=0.019) but not superior to CR (p=0.097). The TR group had significant improvement in resting-state functional connectivity between the bilateral M1 areas compared with the CR group. There was a significant association between M1-M1 resting-state functional connectivity and FMA change in the TR group.
Hassett et al. 2020 **Australia** **RCT**	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☑	300 inpatients recruited from 3 hospitals with mobility limitations, receiving neurological rehabilitation. Approximately 50% of participants had experienced a	Patients were randomized to receive usual care or usual care + an additional intervention that used devices to target mobility and physical activity problems,	**Primary outcomes:** Mobility (performance-based Short Physical Performance Battery [SPPB]) and upright time as a proxy measure of physical activity (proportion of	Intervention participants received on average 12 supervised inpatient sessions using 4 different devices and 15 physiotherapy contacts supporting device use after hospital discharge. The mean improvement in mobility scores was 2.3 in the intervention group and 2.1 in the control group

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		neurological condition. Mean age was 72 years, 50% were women.	individually prescribed by a physiotherapist, including virtual reality video games, activity monitors, and handheld computer devices for 6 months in hospital and at home.	the day upright measured with activPAL) at 6 months	(mean between-group difference was 0.2 points, 95% CI 0.1 to 0.3; p = 0.006). There was no significant difference in the mean proportion of the day spent upright at 6 months: intervention group, 18.2% vs. control group, 18.4%, mean difference=−0.2%, 95% CI −2.7 to 2.3; p = 0.87)
Wu et al. 2020 **China** **RCT**	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☒	64 patients admitted to hospital with acute ischemic or hemorrhagic stroke, with a NIHSS score 5-15 and limb dysfunction, who chose home rehabilitation after hospital discharge. Mean age was 58 years, 60% were men.	Participants were randomized to receive standard inpatient rehabilitation + home remote rehabilitation guidance using the Internet-based TCMeeting v6.0 video conferencing system, installed in the patient's home, providing remote rehabilitation instruction twice a week (experimental group) or weekly rehabilitation phone calls (control group) after discharge. Assessments were conducted on the day of discharge, the 4th 8th and 12th week after discharge	**Primary outcomes:** Fugl-Meyer Assessment (FMA), Berg Balance Scale (BBS) and Timed "UP & GO" (TUG) test **Secondary outcome:** Stroke-Specific Quality of Life Scale (SS-QoL)	There were 3 dropouts (2 in intervention, 1 in control group). Patients in both groups improved over time and from each assessment point to the next) on all outcomes. Patients in the intervention group had significantly greater improvement over time in mean scores for all outcomes (overall time*group interaction).
Cramer et al. 2019 **USA** **RCT (non-inferiority)**	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☑	124 adults recruited from 11 sites who had experienced stroke 4 to 36 weeks prior and had mild to severe arm motor deficits (Fugl-Meyer [FM] score, 22-56). Mean age was 61 years, 27% were	Participants were randomized (1:1) to receive telerehabilitation therapy in the home (TR group) or therapy at an outpatient rehabilitation therapy clinic (IC group). Participants received 36	**Primary outcome:** Change in FM (UE) score from baseline to 4 weeks **Secondary outcome:** Box and Blocks Test, Stroke Impact Scale (SIS) –hand motor	Adherence was high in both groups, (93.4% in IC group and 98.3% in TR group) Persons in both groups improved significantly from baseline to 4 weeks after the end of treatment. The mean unadjusted FM change score was 8.36 points in the IC TR group and 7.86 points in the TR group. The adjusted mean change in FM score was 0.06 points larger in the TR group (95% CI, −2.14 to 2.26; p = .96), which indicated that TR was non-inferior to IC therapy.

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		women. Baseline FM score was 43.	sessions, (18 supervised, 18 unsupervised), 70 minutes each of task-oriented arm motor therapy plus stroke education, with therapy intensity, duration, and frequency matched across groups during a 6–8-week period. The TR system consisted of an internet-enabled computer with table, chair, and 12 gaming input devices.	domain, change in stroke knowledge	Box and Blocks Test scores increased significantly by 9.5 in the TR group and by 8.8 in the IC group and indicated noninferiority of TR therapy. SIS hand motor domain scores increased significantly by 23.7 in the TR group and by 29.2 in the IC group. Non-inferiority of TR was not demonstrated. Stroke knowledge was similar between groups at baseline and follow-up.
Caughlin et al. 2019 **Canada** **Qualitative study**	NA	6 studies, funded as part of the 2013 Tele-Rehabilitation for the Stroke Initiative. Studies included interventions for communication disorders and/or aphasia, an interdisciplinary telerehabilitation delivery platform, gaming software for the treatment of cognitive deficits, a coaching program for stroke management and prevention and virtual reality for upper limb training.	The results from the 6 studies were reviewed with the intention of drawing general conclusions related to cost, efficacy, acceptance by patients and clinicians, and the role of the technology.	General synthesis of lessons learned	Lessons included: (1) Efficacy and cost of telerehabilitation appear to be similar to that of traditional face-to-face management; however, more thorough analyses are needed in this area. (2) Patients are generally satisfied with telerehabilitation services when trained appropriately and some social interaction occurs. (3) Clinician acceptance may be dependent on appropriate training, ease, and time of use, along with adoption by administrators. (4) Selection of telerehabilitation technology should be based on ease of use and targeted to the skills and abilities of users.
Palmer et al. 2019	CA: ☑	278 adults recruited from 21 speech and	Participants were randomly assigned to	**Primary outcomes:**	Participants in the CSLT group had significantly improved word finding compared with those in the usual

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UK **RCT** ***Big CACTUS***	Blinding patient: ☒ assessor: ☑ ITT: ☑	language therapy (SLT) departments, with aphasia post-stroke of at least 4 months duration and had word-finding difficulties. Mean age was 65.4 years, 61% were men. 44% of participants had mild word finding difficulties, 30% had moderate difficulties and 26% had severe difficulties. Median duration post stro0ke was 2 years.	receive either 6 months of usual care (n=101), daily self managed computerized SLT plus usual care (CSLT, n=97), or attention control plus usual care (n=80). Patients in the CSLT group completed daily, self-managed, word-finding exercises on a computer at home, tailored to their individual needs. Practice was supported by a therapy assistant or volunteer. Patients in the attention control group completed paper-based puzzle book activities daily, and received supportive telephone calls from the research team once a month.	Change in word finding ability at 6 months from baseline, change in functional communication at 6 months from baseline, using Therapy Outcome Measures (TOMs) **Secondary outcomes:** Change in patient perception of communication and quality life at 6 months, assessed using Communications Outcomes After Stroke (COAST)	care group (adjusted MD=16·2% 95% CI 12·7–19·6, p<0·0001). Participants in the CSLT group had significantly improved word finding compared with those in the attention control group (adjusted MD=14·4%, 95% CI 10·8- 18·1, p<0.0001). There was no significant improvement in word finding between persons in the usual care and attention control groups. There were no significant changes between CSLT and attention control or usual care groups in functional communication. The mean changes in COAST scores from baseline to 6 months were 0·5, 95% CI (–3·1 to 4·1, p=0·772 (CSLT vs. usual care); 3·8, 95% CI –0·0 to 7·5, p=0·051 (CSLT vs. attention control) and –3·2, 95% CI –7·0 to 0·5, p=0·089 (attention control vs. usual care)
Vloothuis et al. 2019 **The Netherlands** **RCT** **CARE4STROKE**	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☑	66 stroke patient-caregiver couples, recruited from inpatient rehabilitation wards, who had lived independently prior to stroke. Mean age of patients was 60 years, 61% were women. Median time after stroke was 37 days.	Patients were randomized to the CARE4STROKE program, which used an e-Health app that provided an additional 150 minutes a week with a caregiver + usual care or usual care only for 8 weeks.	**Primary outcomes:** Self-reported mobility domain of the Stroke Impact Scale 3.0 (SIS) and length of stay (LOS), assessed at 8 and 12 weeks **Secondary outcomes:** Motor impairment, strength, walking ability, balance, mobility and Extended ADL of	There were no significant differences between groups in SIS mobility scores at either 8 (p=0.229) or 12 weeks (p= 0.961), or LOS (p= 0.818). There were significant differences between groups favouring the intervention group in patient's anxiety at 8 and 12 weeks (p= 0.023, p=0.009) and caregiver's depression at 8 weeks (p=0.003).

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				patients, caregiver strain and mood, self-efficacy, fatigue and quality of life of both patients and caregivers.	
Meltzer et al. 2018 **Canada** **RCT (non-inferiority)**	NA	44 patients with a history of unilateral stroke ≥6 months previously, resulting in a communication disorder (aphasia, n=33 or cognitive-linguistic communication disorder [CLCD], n=11). Mean age was 64 years, 39% were women.	Participants had an initial 2 hour in-person meeting with the therapy team and were then randomized to receive in-person (IP) treatment or remote therapy (telerehabilitation) using teleconferencing equipment. All patients received 10, one-hour weekly sessions.	**Primary outcomes:** Western Aphasia Battery aphasia quotient (WAB-AQ) (for aphasia) and Cognitive-Linguistic Quick Test (CLQT) (for CLCD) and subjective gains with the Communication Confidence Rating Scale for Aphasia (CCRSA) (self-rating) and Communication Effectiveness Index (CETI) (partner rating)	Among the 30 persons with aphasia who completed both assessments, there was no significant difference in the degree of improvement on the WAB-AQ score (mean gain of 7.68 points in TR group vs. 6.58 in IP group, p=0.55). In a formal non-inferiority test, TR was non-inferior to IP treatment. Among persons with aphasia, communication confidence was improved significantly more in the IP group (mean CCRSA change 4.79 vs. 2.18, p=0.028). Mean partner rated CETI gains did not differ between group (TR 11.2 vs. IP 11.9, p=0.83). Among the 11 persons with CLCD, the mean gain in the CLQT language domain did not differ significantly between groups (TR 3.0 vs IP 4.0, p=0.64). There were no significantly different gains between groups in other domains (memory, executive function, attention, visual-spatial).
van den Berg et al. 2016 **The Netherlands** **RCT**	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☑	63 patients recruited from 2 acute stroke units and 1 rehabilitation unit. Mean age was 68.7, 64% were women.	Patients were randomized to an 8-week caregiver-mediated exercises program with support using a customized exercise app loaded onto a tablet or conventional inpatient rehabilitation. In the intervention group, the patient and their caregiver were asked to perform a selective set of exercises for 8 weeks, at least 5 times a week for 30 minutes,	**Primary outcome:** Stroke Impact Scale (SIS) mobility domain **Secondary outcomes:** LOS, other SIS domains, readmissions, motor impairment, strength, walking ability, balance, mobility, (extended) ADL, psychosocial functioning, self-efficacy, quality of life, and fatigue	In ITT analysis, there was no between-group difference in SIS mobility at 8 weeks (mean difference=-2.5, 95% CI -11.9 to -7, p=0.6) p=0.6). In ITT analysis, there were significantly greater improvements in the SIS domains of strength and memory, favouring the intervention group at 12 weeks. There were significant between-group differences in favor of the intervention group for the Nottingham Extended ADL index at week 8 and 12 weeks. In ITT analysis, there were no significant differences between groups in hospital LOS or readmissions during the first year.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			and had a weekly evaluation session with the physiotherapist.		There were significantly greater improvements in the Timed Up and Go test, the Fatigue Severity Scale and the General Self - Efficacy Scale (caregiver) at 12 weeks.
Chumbler et al. 2012, 2015 **USA** ***Stroke Telerehabilitation (STeleR)*** **RCT**	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☒	52 veterans who had suffered a stroke within the previous 2 years, aged 45-90 years, living in the community, without cognitive impairment, and a discharge FIM score of 18-88 were included.	Patients were randomized to a STeleR group (n=25) or to a usual care group (n=23) The STeleR intervention focused on improvement of functional mobility. The program lasted 3 months and included 3 components: 3x 1 hour televisits to the participant's home, 5 telephone calls and an in-home messaging device system to instruct patients on functional exercises and adaptive strategies. Patients in the usual care group could receive any services provided by VA or non-VA, at their discretion	**Primary outcome (2012):** Telephone Version of FIM (FONEFIM), overall function domain of the Late-Life Function and Disability Instrument (LLFDI) **Secondary outcome (2012):** Additional domains of the LLFDI **Primary outcomes (2015):** Falls Efficacy Scale (FES), Stroke-specific Patient Satisfaction with Care Scale (SSPSC)-9 items for hospital care, 4 items for home care Outcomes were assessed a baseline, 3 and 6 months	48 patients completed baseline assessments. **2012** Mean±sd scores for STeleR and usual care groups at baseline and 6 months were: FONEFIM (motor domain): 83.5±9.5 to 83.7±9.9 vs. 81.5±12.1 to 80.9±12.0, p=0.306 LLFDI (overall function total): 49.5±10.1 to 54.6±12.0 vs. 51.7±12.8 to 50.6±11.7, p=0.248 LLFDI (disability components): Personal role frequency: 47.6±10.8 to 49.6±18.1 vs. 49.2±14.8 to 47.2±11.9, p=0.025 Difficulty dimension total: 53.9±21.5 to 68.0±16.6 vs. 62.2±15.3 to 59.5±17.7, p=0.025 Instrumental role difficulty: 52.5±21.5 to 68.1±13.2 vs. 61.2±15.9 to 58.0±18.7, p=0.031. There were no significant differences between groups on any of the other LLFDI function domains (upper, lower or advance lower extremity scores), or the remaining disability components (frequency dimension total and social role frequency) **2015** There were no significant differences in mean baseline FES scores between groups or 6-month follow-up. The scores in both groups increased over time (2.2 vs. 2.3 points) There was a significant increase in the mean SSPSC score (hospital care) at 6 months between groups favouring the STeleR group (+4.5 vs. -3.2, p=0.029).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					There was no significant difference in mean SSPSC score (home care) at 6 months between groups (+1.7 vs. -0.4, p=0.077). Dropouts and losses to follow-up: n=5
Taylor et al. 2009 **Canada** **Feasibility study**	NA	12 patients with stroke, which occurred on average 16 months previously + 4 caregivers. Patients living in long-term care, those still actively participating in a rehabilitation program and those with severe communication difficulties, were excluded.	A self-management program, Moving On after Stroke (MOST) delivered over 9 weeks, with (2 sessions/week, (2 hours/session) was delivered by 2 facilitators at an urban site to 7 participants and their families, also located at the same site and also, remotely, using videoconferencing to 5 participants and their caregivers, located at two remote locations.	**Primary outcomes:** Feasibility (assessed through attendance records, telehealth delivery, required adaptations and staff/participant/caregiver perceptions of the program) **Secondary outcomes:** Reintegration to Normal Living (RNL), Geriatric Depression Scale (GDS), Activity-Specific Balance Confidence Scale (ABC), berg Balance Scale (BBS) and 6-Minute Walk Test (6MWT) were assessed before and after the program and at 3-month follow-up	Average attendance for all participants was 83% (90% for local attendees and 70% for the remote group) 3 technical problems arose over 18 sessions (difficulties connecting remotely, which were resolved within 5 minutes) Participants in both groups reported satisfaction with the program From Baseline to follow-up, there were improvements in all outcomes (mean ±sd): RNL: 3.2±2.9 to 4.3±2.6, p=0.22 GDS: 5.3±3.2 to 3.2±2.3, p=0.04* ABC: 65.6±26.5 to 74.6±12.0, p=0.12 BBS: 48.5±8.5 to 50.2±3.2, p=0.66 6MWT (m): 280.2±96.9 to 251.4±72.3, p=0.02* * Missing values were imputed There were 3 dropouts:
Piron et al. 2009 **Italy** **RCT**	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☒	36 subjects with mild to moderate arm motor impairment (Fugal Meyer Assessment (FMA) upper-extremity scores 30-55) following stroke, which occurred an average of 12 months previously. Subjects with cognitive impairment, neglect or	Patients were randomized to a Tele-rehab (n=18) or a control group (n=18) upper-limb therapy program Patients in the control group were treated with conventional physical therapy and asked to perform exercises progressing in difficulty.	**Primary outcomes:** FMA (upper extremity), Ashworth Scale (AS) scores. Assessments were conducted one month prior to randomization (T0), start of therapy (T1), end of therapy (T2) and at 1-month follow-up (T3).	Mean±sd FMA scores for patients in Telerehab and control groups were: T0: 48.3±7.2 vs. 47.3±4.5 T1:48.5±7.8 vs. 47.3±4.6 T2: 53.6±7.7 vs. 49.5±4.8, p<0.05 T3: 53.1±7.3 vs. 48.8±5.1 Mean±sd AS scores for patients in Telerehab and control groups were: T0: 2.2±1.6 vs. 1.3±1.0 T1:2.4±1.9 vs. 1.3±1.0 T2: 1.7±2.0 vs.1.0±0.8, p<0.05 T3: 2.0±2.0 vs. 1.1±0.9

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
		communication deficits, were excluded	Patients in the Tele-rehab group performed 5 exercises using a PC-based virtual reality system. A therapist provided feedback remotely. The duration of the program for patients in both groups was 1 month (1 hour/day, 5x/week).		
Piron et al. 2008 **Italy** **RCT**	CA: ☒ Blinding patient: ☒ assessor: ☒ ITT: ☒	10 patients with mild/moderate arm motor impairment following ischemic stroke, occurring an average of 10 months previously, without cognitive impairment	Patients were randomized to a 1-month program (1 hour/day) of virtual reality (VR) therapy using telemedicine to participate from home (n=5), or to receive the same VR program in hospital (n=5)	**Primary outcome:** 12-item patient satisfaction questionnaire (5- point Likert Scale 1=strongly disagree, 5=strongly agree), Fugl-Meyer Assessment (upper-extremity portion)	Median patient satisfaction scores for VR vs. Tele-VR groups for each item were: 4 vs.5 4 vs.4 4 vs.4 4 vs.5 4 vs.5 4 vs.5 4 vs.4 4 vs.4 4 vs.3 4 vs.5 4 vs.5 4 vs.5 Mean FMA scores at baseline and end of treatment for patients in the TeleVR group and VR groups were: 51.2 to 56.6 ($p<0.05$) and 49.4 to 56.0 ($p<0.05$)
Huijgen et al. 2008 **The Netherlands** **RCT**	CA: ☒ Blinding patient: ☒ assessor: ☒ ITT: ☒	81 subjects >18 years, with stroke (n=16), TBI or MS, with performance on 9-Hole Peg test (9HPT)>180 sec, who were living at home in stable clinical status. Patients with serious cognitive/behavioural/visual/	Patients were randomized to an intervention group (n=55), consisting of 1 month of usual care, (general exercise program) followed by a 1-month program (30 min, 5 days/week) using the Home Care Activity Desk, using a portable telemedicine system, to	**Primary outcome:** Action Research Arm test (ARAT), 9HPT **Secondary outcome:** User satisfaction (100-point VAS) Outcomes were assessed at baseline, 1 month and 2 months	There were no significant differences between groups at any of the assessment points Mean (±sd) ARAT and 9HPT scores for stroke patients in the control group at T0, T1 and T2 were: 46.7±11.2, 44.3±15.1 and 47.3±40.9; 73.4±58.7, 61.0±45 and 61.0±48.4 2/9 vs. 1/9 stroke patients in the intervention and control groups reported clinically significant improvement (±5.7 ARAT points)

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		communication/problems and medical complications, were excluded.	facilitate upper-limb rehabilitation, or to a control group (n=26) and received usual care for 2 months		Mean (±sd) ARAT and 9HPT scores for stroke patients in the intervention group at T0, T1 and T2 were: 40.7±12.6, 39.3±14.2 and 40.9±13.4 106.4±65.0, 85.5±57.6 and 88.5±54.3 Both patients and therapists were generally satisfied with 6 aspects of the program (acceptance, aesthetic aspect, ease of use, hardness of the task, suitability of the tasks, general opinion). 11 patients were lost to follow up.
Lai et al. 2004 **China** **Single group intervention study**	NA	21 subjects, at least 6-month post stroke, who were able to walk independently, with/without aids. Exclusions included MMSE scores <18, aphasia and pulmonary insufficiency	8-week program (1 session/week, 1.5 hrs/session) conducted at a community centre for seniors, conducted by a physiotherapist via videoconference link. Intervention included education (secondary prevention, medical management, and safety), exercise to improve strength and balance (30 min), and community support	**Primary outcome:** Berg Balance Scale (BBS), State Self-Esteem Scale (SSES), SF-36, stroke knowledge test (10 items) Outcomes were assessed before and after intervention. A focus group was also conducted following the intervention to evaluate satisfaction with the program	19 patients completed the program Mean time post stroke was 3 years. Baseline and post intervention scores (mean±sd): BBS: 42.2±6.7 to 49.0±6.5, p<0.0001 SSES: 64.8±12.3 to 79.8±12.8, p<0.0001 There were significant improvements in all aspects of the SF-36 Knowledge tests: 4.8±1.7 to 8.7±1.5, p<0.0001 63% and 37% of subjects rated the clinical effectiveness of the program as good and excellent, respectively.

Virtual (Remote) Assessment

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Peters et al. 2021 **Canada**	NA	5 persons with remote stroke (≥6 months) living in the community with impairment issues. Mean age was 63	Based on consultation with 7 physiotherapists/ students, a Fugl-Meyer (FM) assessment, suitable for virtual care	**Primary outcome:** Not applicable	*Development* The FM-tele excluded the categories of reflexes, movement out of synergy, and normal reflexes. FM-tele included 4 components from the original FM assessment: a proximal subscore (0-14), knee ankle

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Feasibility/pilot study		years. One participant was a woman.	use (FM-tele) was developed. The feasibility of the newly developed tool was assessed with the input of assessors and individuals with stroke. Finally, agreement between the traditional FM and the FM-tele was assessed.		subscore (0-4) and a coordination/speed subscore (0-6). Total scores range from 0-24. *Feasibility* All patients reported having some technical difficulties. The most common problems were with the iPad screen freezing and the inability to access clear audio. All of the assessors reported having some difficulty with the software; glitches were common. *Agreement* Proportional agreement between the FM-tele conducted in person and conducted remotely by the same assessor, one week apart was 4/5 for all flexor-synergy and extensor synergy items. Proportional agreement for both items of movement combining synergy items was 5/5. For coordination/speed, agreement was 5/5 for tremor, 3/5 for dysmetria and 2/5 for speed Total in person FM-tele scores for the 5 patients were: 18, 20, 20, 12 and 20. Corresponding total score assessment for remote were: 16, 20, 23, 13 and 21 out of a possible 24 points.
Gillespie et al. 2021 **Canada** **Reliability study**	NA	20 persons with stroke recruited from an early supported discharge program, or a physiotherapy clinic. Mean age was 73 years, 55% were men. Mean FIM score was 111. All participants walked independently or with supervision, most with the use of a gait aid.	Two raters, a physiotherapist and an occupational therapist, each administered the Berg Balance Scale (BBS) to all participants, using both telerehabilitation (videoconferencing) and traditional in-person approaches, in random order. During the telerehabilitation assessment, clinicians were located in a hospital, while	**Primary outcome:** Inter-rater reliability	The initial assessment was performed an average of 50 days post stroke (n=18). In 2 cases, stroke had occurred years previously. The mean BBS scores were 47.7 using telerehabilitation and 47.0, in person. The agreement between raters was excellent using Krippendorff's α (0.97, 95% CI 0.96-0.99) and Cohen's κ (0.97, 95% CI 0.96- 0.99). The intra-class correlation coefficient (ICC) for total BBS score was 1.0. For individual BBS items, ICCs ranged from 0.81-0.99. Agreement was highest for the items of standing with eyes closed (ICC = 0.99, 95% CI 0.94- 0.99) and pick up object (ICC= 0.97, 95% CI 0.93-0.99).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			participants and therapy assistants were located at participants' home. During the in-person portion, assessments were conducted in the patient's home.		Agreement was lowest for the items of turning to look behind (ICC=0.84 95% CI 0.61- 0.94) and tandem stance (ICC=0.81 95% CI 0.52- 0.93).
Amano et al. 2018 **Japan** **Reliability study**	NA	30 persons recovering from stroke with hemiparesis, recruited from a single site. Median age was 65.5 years, 40% were women. Median time since stroke was 41.2 months.	Assessments of 2 measures (the arm section of the Fugl-Meyer Assessment [FMA] and the Action Research Arm Test [ARAT] were conducted by 2 trained assessors, using direct observation and video observation of each participant. The direct observation assessment was video-recorded for the video observation assessment.	**Primary outcome:** Inter-rater reliability	Median FMA score was 44 using direct assessment and 43 using video assessment. Median ARAT score was 41 for both direct assessment and video assessment The intra-class correlation coefficient (ICC) for total FMA scores was 0.998 (95% CI 0.995-0.999). ICCs for the sum of individual items within each section ranged from 0.992 to 0.998. Spearman's *r* for total FMA scores was 0.992 (95% CI 0.983-0.996). Correlations for the sum of individual items within each section ranged from 0.986 to 1.000. The intra-class correlation coefficient (ICC) for total ARAT scores was 0.998 (95% CI 0.996-0.999). ICCs for individual the sum of items within each section ranged from 0.980 to 0.999. Spearman's *r* for total ARAT scores was 0.993 (95% CI 0.984-0.997). Correlations for the sum of individual items within each section ranged from 0.949 to 0.997.
Palsbo et al. 2007 **USA** **Prospective study**	NA	24 adults recovering from stroke who were currently receiving outpatient or inpatient therapy for speech or physical problems. Median age was 64 years, 75% were men.	Participants were randomized to a remote or face-to-face administration of a subset of the Boston Diagnostic Aphasia Examination (BDAE) and to remote or face-to-face assessment of 3 of 11 constructs from the National Outcomes	**Primary outcome:** Agreement	*Face-to-face administration of BDAE* Percentage within the 95% limits of agreement/percent exact agreement Motor speech 92%/67% Speech comprehension 92%/50% Speech expression 92%/50% *Remote administration of BDAE* Percentage within the 95% limits of agreement/ percent exact agreement Motor speech 100%/25%

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			Measurement System (speech comprehension, speech expression and motor speech). Assessments were conducted by 4 Speech-Language Pathologists (SLP) at 2 sites. Remote and in-person assessments were conducted simultaneously.		Speech comprehension 92%/8% Speech expression 100%/25%

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