Position Statement

Telepractice in Speech Pathology

Acknowledgements

Contents

1. Background

The idea of using information and communication technology to enhance speech pathology practice is not new. Research into telepractice has been conducted since the 1970s. However, the rapid growth in inexpensive, sophisticated technology, coupled with expanding access to communication networks, has led to widespread professional interest in this service delivery model. In response to this, some professional associations are developing position statements and guidelines for the use of telepractice in speech pathology. Given Australia's geographically dispersed population and the consequent inequity of access to services, as well as the increasing demand for speech pathology services, Speech Pathology Australia has developed this position statement on telepractice.

This position statement has been produced to assist speech pathologists considering implementing telepractice in the Australian context. It may also be of use when lobbying for new service delivery models to meet increasing demand for speech pathology services. The position statement has been informed by current available evidence on the use of telepractice (published between 2004-2014), existing national and international position statements and guidelines (see ACCRM, 2012; ASHA, n.d; ATA, 2014; Brennan et al., 2010; CALSPA, 2006; National Initiative for Telehealth Guidelines, 2003) professional community consultation, and consensus opinion. A summary of the current evidence for the delivery of speech pathology services via telepractice is available in Appendix A. This summary is further supplemented by specific information regarding the levels of evidence. The Australian National Health and Medical Research Council (NHMRC) Evidence Hierarchy has been used to grade the evidence. This supplementary information is available in Appendix B.

2. Definitions

2.1 Definition of telepractice

Telepractice is the application of telecommunications technology to deliver clinical services at a distance by linking clinician to client, caregiver, or any person(s) responsible for delivering care to the client, for the purposes of assessment, intervention, consultation and/or supervision.

Integral to telepractice is the delivery of clinical services over any distance that are guided, monitored, or modified by a speech pathologist for each unique client or clinical purpose. Telepractice has the potential to increase access to speech pathology services across the life span.

"Telepractice" can also be known by these terms: *telehealth, telerehabilitation, telespeech, or teleSLP.*

Telepractice forms part of a larger concept known as e-Health which is a term given to electronic processes and communication technology which supports healthcare practice. E-Health includes, but is not limited to electronic medical records and technology-delivered self-guided consumer education and training (e.g. therapy software apps). While integral to the provision of healthcare, they are not within the scope of this document.

2.2 Telepractice models of service delivery

Telepractice may encompass individual sessions, group sessions, specialist clinical consultation, and clinical training/supervision. Telepractice service delivery may be provided between individual sites or multiple sites. Telepractice encompasses synchronous (real-time delivery) or asynchronous (delayed delivery/store and forward) formats. A hybrid model is also utilised which combines these two technologies (e.g. videoconferencing with store and forward capabilities) to optimise clinical decision making in the presence of unreliable infrastructure/connectivity (Keck & Doarn, 2014). The technologies that are associated with telepractice include the clinical use of videoconferencing (both hardware and software), teleconferencing, email, and store and forward of clinical data.

3. The Position of Speech Pathology Australia

The following statements articulate the position of Speech Pathology Australia (The Association) on regarding telepractice in speech pathology practice. These statements have been informed by current evidence, national and international aged care policy and recommendations, and consensus opinion.

3.1 Speech Pathology Australia supports the use of telepractice as a service delivery model where telepractice is based on current evidence-based practice and is at least equivalent to standard clinical care.

Telepractice services should be implemented based on current evidence and offered with at least the same level of access and frequency of intervention, such that the telepractice service is at least equivalent to the current clinical care. Endorsement should be obtained from the relevant service provider/organisation prior to implementing a telepractice service. Those clinical services with little existing evidence using telepractice should be developed and implemented utilising an approach that follows concept development, pilot testing, implementation, and evaluation of the new service against standard clinical care. Established telepractice services, as with standard care, should undergo routine review to determine if outcomes are being met and maintained.

3.2 Clinicians using telepractice are bound by professional practice documents and existing national and facility based guidelines as per standard clinical care, ensuring that a telepractice service meets necessary technical and clinical standards.

As with standard care, clinicians using telepractice are bound by professional practice documents including Speech Pathology Australia's Code of Ethics (Speech Pathology Australia, 2010), Parameters of Practice (Speech Pathology Australia, 2007), Credentialing Position Statement (Speech Pathology Australia, 2009) and existing national and facility based guidelines. Speech pathologists engaging in telepractice should possess the necessary knowledge and skills to provide the level of clinical service required, as they would in standard care.

3.3 The appropriateness to deliver services using telepractice must be made on a case-by-case basis considering individual client, technical and environmental factors, with clients providing informed consent.

Clinicians should evaluate an individual client's needs and determine if the clinical procedures can be appropriately modified for implementation within a telepractice model. Client eligibility and selection should consider physical and sensory (vision/hearing) status, cognitive functioning including attention and concentration, presence and severity of communication deficits, cultural and linguistic diversity, technical availability and capacity, the physical environment in which to conduct the service, and the availability of trained staff/carer to support the telepractice sessions. Informed consent should be obtained from both service providers and clients prior to engaging in a telepractice service, including disclosure regarding the benefits and limitations of the telepractice service and any alternatives to telepractice care.

3.4 Opportunities for feedback must be available to all consumers engaged in a telepractice service with avenues for reporting to the governing service provider.

Consumer engagement is imperative to support service acceptance and to overcome barriers for telepractice service implementation and sustainability. Processes should be developed to enable both clients and service providers to give feedback regarding the telepractice service during its development, implementation, and review. Consumer feedback should also be utilised for sustaining, improving and expanding telepractice services.

3.5 Clinicians must have competency in the clinical service being delivered and the operation of the telepractice equipment being used to deliver the service.

Clinicians undertaking telepractice should be appropriately trained to operate the telepractice equipment and deliver the modified clinical service. This knowledge and skill base should be reviewed, maintained, and updated to meet advancements in technology and telepractice services. Any training required is the responsibility of the service provider and must be maintained in accordance with clinical and operational standards.

3.6 Organisations engaging in telepractice must have access to technical support such that equipment is selected, configured, maintained, and upgraded to meet the necessary clinical and service requirements.

A thorough understanding is required of the telepractice environment (site based versus home based services) and the telepractice systems (i.e. hardware vs software/mobile devices) to be used. This includes audio-visual capability, peripheral devices, interoperability between the prospective systems and network quality. Telepractice services should be supported as per standard care. The physical environment in which the service is delivered should be safe, confidential, and modified (e.g., lighting) to optimise the telepractice session. Adherence to relevant policies and regulations regarding technology and technical safety are essential. Compliance with Australian privacy legislation must be met to ensure client-clinician confidentiality is maintained when utilising the chosen technological platform/network (e.g. videoconferencing via secure versus insecure networks). Appropriate workplace documentation (i.e. health information) and procedures (e.g. infection control) should also be followed.

3.7 Speech Pathology Australia supports educational opportunities to stimulate and facilitate the development of telepractice knowledge and skills to progress the application of telepractice in clinical and professional services.

The uptake and sustainability of telepractice as a model of care requires that educational programs include evidence-based theoretical and practical training of telepractice in their curriculum. Ideally these educational programs should enable students to suitably determine and facilitate the translation of current clinical services into a telepractice model, where appropriate.

3.8 Speech pathology services using telepractice should evaluate clinical, economic and consumer outcomes to guide the implementation, expansion, and sustainability of telepractice services.

Financial costs (e.g. human, capital and technological resources) should be considered when establishing and maintaining a telepractice service. Identifying the benefits and cost effectiveness of telepractice services is essential for development, uptake and sustainability.

3.9 Speech Pathology Australia supports the development and implementation of reimbursement and funding models to support the uptake and sustainability of telepractice services.

Within Australia, there are currently limited reimbursement models for telepractice delivered by speech pathologists and this contributes to the barriers for uptake of telepractice in public and private speech pathology services. Although some speech pathology studies have reported the potential for cost savings using telepractice, further research is required to advocate for mainstream reimbursement for telepractice services in speech pathology.

3.10 Speech Pathology Australia acknowledges the need for continued high quality research into the application of telepractice to speech pathology services in order to expand the evidence-base for this service delivery model.

The current evidence for telepractice delivery of speech pathology services is steadily growing. However, further funding is required to support high quality research projects that promote the

implementation of telepractice into speech pathology services. Appendix A summarises the current evidence.

4. Conclusion

The purpose of this position paper is to highlight to speech pathologists and service organisations the key issues to be considered when designing and implementing telepractice services. This position statement has also been produced to inform policy makers, government, and funding bodies of the evidence-base for using telepractice in speech pathology services.

Speech Pathology Australia recognises that telepractice may address some of the issues of inequity of access to speech pathology services in Australia and that demand for this service delivery model is increasing. It is critical that the outcomes from speech pathology services using telepractice are at least comparable to current clinical care. In addition telepractice services may offer the opportunity to enhance existing models of care. Speech Pathology Australia acknowledges that the evidence-base for telepractice is rapidly evolving and that as technology and communication infrastructure becomes more sophisticated and accessible this evidence-base will continue to grow.

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Ward, E., Crombie, J., Trickey, M., Hill, A., Theodoros, D., Russell, T. (2009). Assessment of communication and swallowing post-laryngectomy: A telerehabilitation trial. *Journal of Telemedicine and Telecare*, *15* (5), 232-237.

Ward, E.C., Sharma, S., Burns, C., Theodoros, D.G., & Russell, T.(2012). Validity of conducting clinical dysphagia assessments with patients with normal to mild cognitive impairments via telerehabilitation. *Dysphagia, 27*(4), 460-472.

Ward, E.C., Burns, C., Theodoros, D.G., & Russell, T. G. (2014). Impact of dysphagia severity on clinical decision making via telerehabilitation. *Telemedicine Journal and e-Health, 20* (4), 296-303.

Ward, E.C. & Burns, C.L. (2014). Dysphagia management via telerehabilitation: A review of the current evidence. *Journal of Gastroenterology and Hepatology Research*, 3 (5), 1088-1094.

Whitehead, E., Dorfman, V., Tremper, G., Kramer, A., Sigler, A., & Gosman, A. (2012). Telemedicine as a means of effective speech evaluation for patients with cleft palate. *Annals of Plastic Surgery, 68,* 415- 417.

Wilson, L., Onslow, M., & Lincoln, M. (2004). Telehealth adaptation of the Lidcombe Program of early stuttering intervention: five case studies. *American Journal of Speech-Language Pathology, 13*, 81-93.

Appendix A: Evidence for Speech Pathology telepractice services

The following are summaries of current evidence for the use of telepractice for the delivery of speech pathology services. It is important to understand that this evidence relates to specific technology and describes assessment and treatment protocols modified for use by telepractice. The reader should refer to Appendix B for further details and relevant considerations outlined in the literature for telepractice delivery.

Childhood speech and language disorders

Validity and reliability has been established for the use of telepractice in a number of screening and formal language, oromotor, articulation and literacy assessments (Level III)(Ciccia, Whitford, Krumm, & McNeal, 2011; Crutchley, Dudley, & Campbell, 2010; Eriks-Brophy, Quittenbaum, Anderson, & Nelson, 2008; Fairweather, Parkin, & Rozsa, 2004; Waite, Cahill, Theodoros, Busuttin, & Russell, 2006; Waite, Theodoros, Russell, & Cahill, 2010a, 2010b, 2012). Telepractice has also been used by multidisciplinary teams to assess young children with multiple disabilities (Level IV) (Pearl et al., 2014) and following paediatric brain injury (Level I to III) (Kurowski et al., 2013, 2014; Rietdijk, Togher & Power, 2012; Wade S., Carey, J., & Wolfe, C, 2006; Wade et al., 2010). The use of telepractice in speech and language therapy with school aged children has also been reported, with a randomised controlled trial providing evidence for the provision of speech sound treatment (Level II) (Grogan-Johnson, Schmidt, Schenker, Alvares, Rowan, & Taylor, 2013). Further evidence supports the use of telepractice in speech and language therapy for school aged children (Level III) (Gabel, Grogan-Johnson, Alvares, Bechstein, & Taylor, 2013; Grogan-Johnson, Alvares, Rowan, & Creaghead, 2010; Grogan-Johnson, et al., 2011), along with the communication training of caregivers to support children with Autism Spectrum Disorder (Level IV) (Baharav & Reiser, 2010; Suess et al., 2014; Wacker et al., 2013; Vismara, McCormick, Young, Nadhan, & Monlux, 2013). Synchronous and hybrid models using hardware and PC-based videoconferencing systems have been used. The technical capabilities of the system are important to consider (e.g., audio and visual quality including the capability to view oral structures), particularly in relation to ensuring reliable assessment.

Adult speech and language disorders

There is evidence supporting telepractice assessment of speech and language disorders for acquired and developmental neurological conditions using standardised assessments, informal assessments, and discourse analysis (Level II to IV)(Brennan, Georgeadis, Baron & Barker, 2004; Constantinescu et al., 2010; Georgeadis, Brennan, Barker & Baron, 2004; Hill et al., 2006; Hill, Theodoros, Russell, Ward & Wootton, 2008; Hill, Theodoros, Russell &Ward, 2009a, 2009b; Palsbo, 2007; Parmanto, Pulantara, Schutte, Saptono, & McCue, 2013; Theodoros, Hill, Russell, Ward & Wootton, 2008; Turkstra, Quinn-Padron, Johnson, Workinger, & Antoniotti, 2011). Studies have also shown equivalency with standard care in the delivery of treatment for language and cognitive communication disorders and the training of caregivers (Level II to IV) (Bergquist et al., 2009; Bergquist, Thompson, Gehl, & Pineda, 2010; Bourgeois, Lenius, Turkstra & Camp, 2007; Dechene et al., 2011; Forduecy, Glueckauf, Bergquist, Maheu, & Yutsis, 2012; Goldberg, Haley & Jacks, 2012; Kurland, Wilkins & Stokes, 2014; Man, Soong, Tam, & Hui-Chan, 2006a, 2006b; Mortley, Wade & Enderby, 2004; Ng, Polatajko, Marziali, Hunt & Dawson, 2013; Riegler, Neils-Strunjas, Boyce, Wade & Scheifele, 2013; Sander, Clark, Atchison & Rueda, 2009; Schoenberg et al., 2008; Soong, Tam, Man, & Hui-Chan, 2005). These studies have utilised synchronous, asynchronous and hybrid models using hardware and PC-based videoconferencing and mobile platforms, as well as telephone based interaction, along with instant and short messaging systems (SMS).

Fluency

Evidence (Level II to IV) suggests that telepractice delivery of Lidcombe Program with young children and Camperdown Program with adolescents and adults is efficacious (Bridgman, Block, Onslow, O'Brian, & Jones, 2014; Carey, O'Brian, Onslow, Block, Jones, & Packman, 2010; Carey, O'Brian, Onslow, Packman, & Menzies, 2012; Lewis, Packman, Onslow, Simpson, & Jones, 2008; O'Brian, Packman, & Onslow, 2008; O'Brian, Smith, & Onslow, 2014; Wilson, Onslow, & Lincoln, 2004). Studies have described synchronous models of telepractice treatment delivery using the telephone and home-based videoconferencing utilising personal computers and webcams. Randomised control trial evidence has shown that for the Lidcombe Program the number of consultations to reach Stage II using telepractice is equivalent to in-clinic delivery (Bridgman, et al. 2014). For the Camperdown Program with adults, randomised control trial evidence has shown telepractice delivery required fewer SLP contact hours than in-clinic delivery (Carey et al., 2010).

Voice disorders

The evidence for the management of voice disorders via telepractice has primarily come from studies exploring the delivery of the LSVT®LOUD program to people with Parkinson's disease (Level II & III) (Constantinescu, Theodoros, Russell, Wilson & Wootton, 2011; Constantinescu,Theodoros, Russell, Wilson & Wootton, 2010; Howell, Tripoliti, & Pring, 2009). Equivalency has been established for both assessment and management, however, the technology used and/or the telepractice model must be capable of capturing or transmitting voice signals over a distance "without compromising their acoustic integrity" (Keck & Doarn, 2014, p.4). Hybrid models (e.g., synchronous with store and forward capacity) have dominated research into the use of telepractice in the management of voice disorders. A small cost comparison study revealed that substantial cost reductions are possible using a telepractice model (Level IV) (Towey, 2012).

Dysphagia

Studies have confirmed the feasibility, reliability and validity of conducting adult clinical bedside swallowing assessments via telepractice (Level III) (Sharma, Ward, Burns, Theodoros & Russell, 2011; Ward, Sharma, Burns, Theodoros, & Russell, 2012; Ward, Burns, Theodoros, & Russell, 2014). Assessment outcomes were not influenced by patient severity status when using a customised PC based videoconferencing system. Specific modifications including split screen display, zoom camera, clear utensils, and a trained assistant at the client end to support the assessment are recommended. Asynchronous Videofluoroscopic Swallow Study telepractice models have been used effectively to facilitate accurate dysphagia diagnosis and avoid suboptimal clinical decision making (Level III) (Malandraki, McCullough, He, McWeeny, & Perlman, 2011; Malandraki, Markaki, Georgopoulous, Bauer, Kalogeropoulos, & Nanas, 2013).

Craniofacial and Head & Neck disorders

Telepractice has been used effectively for oromotor, speech, and swallowing assessments and speech and swallowing rehabilitation following both surgical and non-surgical intervention for head and neck cancer. In the laryngectomy population, telepractice has been used effectively to support oromotor and dysphagia assessments, alaryngeal communication training, surgical voice restoration, stoma management and respiratory rehabilitation (Level III & IV) (Burns, Ward, Hill, Malcolm, Bassett et al., 2012; Ward et al., 2007; Ward et al., 2009). These studies utilised hybrid telepractice models using hardware and customised PC based videoconferencing platforms. Two studies have reported the effectiveness of using synchronous videoconferencing for the management of cleft palate disorders (Level III & IV) (Glazer et al., 2011; Whitehead et al., 2012). Technical and operational requirements reported for using telepractice in head and neck disorders include high speed image transfer, use of medical camera systems, additional lighting sources, and trained support staff to facilitate clinical procedures at the client end.

Hearing impairment

There is evidence for the use of telepractice to deliver communication intervention to children with hearing impairment, with equivalency established for language outcomes using PC-based videoconferencing (Level II & III) (Blaiser, Behlm, Callow-Heusser, & White, 2013; Constantinescu et al., 2014). A cost effectiveness analysis indicated that cost savings increased as intensity of service delivery increased (Blaiser et al., 2013).

Clinical supervision and professional mentoring

Tele-supervision or e-supervision programs have provided clinical support to graduate speech pathology students via synchronous videoconferencing, instant messaging, and email. While not all work contexts can be supervised using telepractice, studies have reported benefits for both the supervisor and supervisee (Level IV) (Carlin, Milam, Carlin, & Owen, 2012; Carlin, Boarman, Carlin, & Inselmann, 2013). Synchronous and hybrid methods have also used hardware platforms effectively to support professional mentoring and education with the benefit of improving knowledge/skill base. (IV) (Burns et al., 2012).

Appendix B: Studies Providing Evidence for the use of Telepractice in Speech Pathology

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Childhood speech and language disorders					
Baharav & Reiser. (2010). Using telepractice in parent training in early autism. *Telemedicine and e-Health, 16*, 727-31.	Single subject, time series, repeated measures	IV	N=2 Parents of children with ASD, aged 4:6 and 5:2	1. Observation and coaching. Of live parent-child interactions. 2. Live PC-based two-way video conferencing between clinician and parent using Skype. 3. Network not reported	Child gains observed following twice weekly clinic based intervention sessions were maintained or even exceeded when 1 session per week was replaced with telepractice based parent coaching.
Ciccia et al., (2011). Improving the access of young urban children to speech, language and hearing screening via telehealth. *Journal of Telemedicine and Telecare, 17*, 240-244.	Comparison between telepractice and FTF delivery	III	Screening: n=10 (out of total N=411) children aged < 6 years; Satisfaction: n= 160 families	1. REEL-3, SKOLD, PLS-4, PLS-4 Articulation Screener, and hearing screening. Satisfaction Ratings 2. PC-based videoconferencing (Skype) 3. IP, bandwidth not stated	Language and speech assessment reliable in terms of pass/fail rates online vs. FTF. High family satisfaction.
Crutchley et al., (2010). Articulation assessment through videoconferencing: A pilot study. *Communications of Global Information Technology, 2,* 12-23.	Simultaneous assessment to compare telepractice to FTF.	III	N= 5 School-aged children with speech-sound disorder	1. GFTA-2 2. Hardware videoconferencing 3. H.323 network technology, bandwidth up to 2 Mbit/s	Overall high agreement with high degree of variation between individual phonemes.
Eriks-Brophy et al., (2008). Part of the problem or part of the solution? Communication assessments of Aboriginal children residing in remote communities using videoconferencing. *Clinical Linguistics and Phonetics, 22*, 589-609.	Simultaneous assessment to compare telepractice to FTF.	III	N=7 Canadian Aboriginal children aged 4-13 years with delayed speech or language development	1. PLS-4, PPVT-III, CELF-4, EOWPVT, GFTA-2. 2. Videoconferencing, details not provided; 3. Terrestrial transmission, bandwidth not stated	High agreement on language assessment; variable agreement on articulation assessment. Differences on certain classes of sounds; perhaps due to system issues. Telepractice can be effective complement to provision of services to Aboriginal children when procedures put in place to minimise cultural bias.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Childhood speech and language disorders					
Fairweather et al., (2004). *Speech and language assessment in school-aged children via videoconferencing.* In B.E. Murdoch, J. Goozee, B. Whelan & K. Docking (Eds.), Proceedings of the 26th World Congress of the International Association of Logopaedics and Phoniatrics (IALP) Melbourne, Australia: Speech Pathology Australia.	Simultaneous assessment to compare telepractice to FTF.	III	N = 13 Children aged 6-14 years.	1. GFTA-2, CELF-3, informal conversation sample and oromotor assessment 2. Videoconferencing. 3. Network not reported	High overall agreement on CELF-3 ratings. Generally high agreement on oromotor and articulation assessment. Lower levels of agreement for severe speech disorder and on some phoneme classes.
Gabel et al., (2013). A field study for telepractice intervention using the ASHJA NOMS K-12 database. *Communication Disorders Quarterly, 35,* 44-53.	Telepractice compared with the K-12 Schools National Outcomes Measurement System (NOMS) of ASHA	III	N = 71 Children with speech, language, pragmatic, stuttering and/or voice disorders	1. ASHA NOMS database 2. PC-based videoconferencing systems with headsets and built in microphone 3. Optical Connection-3 to the Ohio Academic Resources Network to reach the T1 connection at each K-12 school. Used 128kbit/s IP	The findings suggest many similarities between the characteristics of the telepractice and direct, in-person service delivery models. The telepractice service delivery model was effective for most students included in the study
Grogan-Johnson et al., (2010). A pilot study comparing the effectiveness of speech language therapy provided by telemedicine with conventional on-site therapy. *Journal of Telemedicine and Telecare, 16,* 134-139.	Counterbalance design. Students randomly assigned.	III	N= 34 Children with stuttering, speech sound production and language impairment	1. GFTA-2 2. PC-based videoconferencing with document camera was used for telepractice at the remote sites. 3. Videoconferencing occurred on the educational network at a minimum bandwidth of 10Mbit/sec.	Videoconferencing seems to be a suitable alternative service delivery to providing speech pathology intervention in schools.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Childhood speech and language disorders					
Grogan-Johnson et al., (2011). A pilot exploration of speech sound intervention delivered by telehealth to school-aged children. *International Journal of Telerehabilitation, 3*, 39-42	Compared telehealth and FTF therapy. No random assignment of students and/or clinicians.	III	N=13 Children with speech sound production disorders	1. GFTA-2 & TinyEYE Speech Therapy Software 2. PC-based videoconferencing systems with built in microphones. An audio splitter to allow student assistant to listen to treatment session. 3. Network not reported	Students in both groups made progress with respects to their speech goals. Videoconferencing appears to be a feasible alternative service delivery model for delivery speech sound intervention into rural schools.
Grogan-Johnson et al., (2013). A comparison of speech sound intervention delivered by telepractice and side-by-side service delivery models. *Communication Disorders Quarterly, 34*, 210-220.	Randomised control trial.	II	N=14 Children aged 6-10 years with speech sound impairment.	1. Speech sound intervention consisting of 2 x 30 min sessions for 5 weeks 2. PC-based videoconferencing (Polycom PVX) 3. 10Mbit/s switched connection.	Children in both groups improved in speech sound production. No significant differences between telepractice and FTF groups post treatment.
Kurowski et al., (2013). Online problem-solving therapy for executive dysfunction after child traumatic brain injury. *Pediatrics*, *132*(1), e158-166. Kurowski et al., (2014). Long-term Benefits of an Early Online Problem-Solving Intervention for Executive Dysfunction After Traumatic Brain Injury in Children: A Randomised Clinical Trial. *JAMA Pediatrics, 168* (6), 523-531.	Randomised controlled trial	II	N = 132 Adolescents with TBI	1. Counsellor-assisted problem solving intervention delivered via videoconferencing with clinician (intervention) compared to provision of internet resources with no clinician involvement (control) 2. PC-based videoconferencing (Skype) 3. High speed Internet	Significant improvement in executive function behaviours at follow-up in the intervention group compared to the control group. Effects from RCT sustained at 12 months post intervention.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Childhood speech and language disorders					
Pearl et al., (2014) International Telemedicine Consultations for Neurodevelopmental Disabilities. *Telemedicine and e-Health, 20* (6), 559-562.	Multiple time series study. Weekly telehealth sessions between team in the USA, to clinicians, families, and clients in based in eastern remote UAE.	IV	N=48 Children with Developmental Disability	1. Purpose built rooms that allowed for direct patient consultation and education via videoconferencing were established in UAE. 2. Hardware videoconferencing using video processor, and projector were installed along with software via a multitouch monitor 3. 768kpbs.	Weekly telehealth videoconferencing sessions in conjunction with triannual training conferences was an effective service delivery model to patients with neurodevelopmental disabilities across international borders.
Rietdijk et al., (2012). Supporting family members of people with traumatic injury using telehealth: A systematic review. Journal of Rehabilitation Medicine, 44, 913-921	Systematic review of level II studies	I	N = 24 peer reviewed articles reporting on 16 studies (7 articles on cognitive communication therapy).	1. Intervention involving family member of adult or child with TBI via telehealth. 2. Searched Medline, CINAHL, PsycINFO, Web of Science, Scopus, the Cochrane library, Embase, PsycBITE and ProQUEST 3. evaluated using PEDroP scale	Seven randomised controlled trials, four non-randomised controlled trials, and five case series studies. 15 out of 16 studies reported positive outcomes of the telehealth intervention. Few studies used blinded assessors.
Suess et al., 2014 Evaluating the Treatment Fidelity of Parents Who Conduct In-Home Functional Communication Training (FCT) with Coaching via Telehealth. *Journal of Behavioral Education, 23*, 34–59	Case Series, multi element	IV	N=3 Parents of children with ASD, aged 2:7 to 3:3	1. Initial FCT training and then viewing and recording treatment sessions. 2. PC Based videoconferencing between office based clinician and client at home using Skype and Debut software 3. Network not reported	Parents who received FCT via telehealth performed equally well when applying the intervention independently or during telehealth based coaching. Children's problem behaviour reduced. Results suggest that FCT via telehealth can result in successful implementation of the approach for children with ASD.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Childhood speech and language disorders					
Wacker et al., (2013). Conducting Functional Communication Training via Telehealth to Reduce the Problem Behavior of Young Children with Autism. *Journal of Developmental and Physical Disabilities. 25*, 35–48	Non concurrent multiple baseline	IV	N=17 Parents of children with ASD, aged 18 to 83 months	1. Office based clinician and local clinic based clients 2. Windows-based PC, webcam and headset for audio and video transmission with teleconferencing and playback software to view and record sessions. 3. "reliable high speed Internet"	Wacker et al reported similar results between telehealth based coaching of parents delivering FCT intervention vs FTF on-site coaching. Children showed reduction in targeted problem behaviour. Reduction in cost of delivering telehealth based service vs FTF was estimated
Wade et al., (2010). A randomized trial of teen online problem solving for improving executive function deficits following pediatric traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 25*(6), 409-415.	Randomised controlled trial	III	N = 41 Adolescents with TBI	1. Teen online problem solving program delivered via videoconferencing compared to provision of internet resources with no clinician involvement. 2. PC-based videoconferencing 3. High speed internet	Adolescents with severe TBI in the intervention group had significantly greater improvements in self-reported executive function compared to the control group. This treatment effect was not observed for adolescents with moderate TBI. No treatment effects were observed on parent-reported executive function skills.
Wade et al., (2006). The efficacy of an online cognitive behavioral family intervention in improving child behavior and social competence following pediatric brain injury. *Rehabilitation Psychology,51*(3), 11.	Randomised controlled trial	III	N = 39 families of children with TBI	1. Family problem solving program delivered via videoconferencing with clinician (intervention) compared to provision of Internet resources with no clinician involvement (control) 2. PC-based videoconferencing 3. High speed internet	Child self-management and compliance was significantly better for the intervention group than the control group at follow-up.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Childhood speech and language disorders					
Waite et al., (2006). A pilot study of online assessment of childhood speech disorders. *Journal of Telemedicine and Telecare, 12*(S3), 92-94.	Randomised simultaneous assessment (SLP & participant). Reliability for telepractice ratings.	III	N=6 Children with speech sound disorder aged 4- 7 years	1. Informal articulation, intelligibility and oromotor assessment 2. Customised PC-based videoconferencing with store and forward capabilities. 3. 128 kbit/s IP	High overall agreement between telepractice and FTF assessments. High intra- and inter-rater agreement on most online measures.
Waite et al., (2010a). Assessment of children's literacy via an Internet-based telehealth system. *Telemedicine and E-health, 16*, 564-575.	Randomised simultaneous assessment (SLP & participant). Reliability for telepractice and FTF ratings.	III	N=20 Children with diagnosed or suspected delays in literacy, aged 8-13 years	1. QUIL, Neale-3, SAST 2. Customised PC-based videoconferencing with store and forward capabilities. Touchscreen at client end. 3. 128 kbit/s IP	Very good agreement for most measures. Very good inter- and intra-rater reliability. Modifications to technology would improve system efficiency and usability. Results support validity and reliability of telepractice.
Waite et al., (2010b). Internet-based telehealth assessment of language using the CELF-4. *Language, Speech, and Hearing Services in Schools, 41*, 445-458.	Randomised simultaneous assessment (SLP & participant). Reliability for telepractice and FTF ratings.	III	N=25 Children with diagnosed or suspected language impairment aged 5-9	1. Core subtests of CELF-4 2. Customised PC-based videoconferencing with store and forward capabilities. Touchscreen at client end. 3. 128 kbit/s IP	Very good agreement on all measures. Very good inter- and intra-rater reliability. Higher bandwidth recommended for system efficiency.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Childhood speech and language disorders					
Waite et al., (2012). Assessing children's speech intelligibility and oral structures, and functions via an Internet-based telehealth system. *Journal of Telemedicine and Telecare, 18*, 198-203.	Randomised simultaneous assessment (SLP & participant). Reliability for telepractice and FTF ratings.	III	N=20 Children with identified or suspected speech sound disorder aged 4-9 years.	1. Informal intelligibility and oromotor screening assessment 2. Customised PC-based videoconferencing with store and forward capabilities. 3. 128 kbit/s IP	High agreement and reliability for intelligibility scale. Mixed levels of agreement for oromotor assessment with comparable levels of inter- and intra-rater reliability of online and FTF ratings; mainly attributed to subjective nature of assessments. Overall results support validity and reliability.
Vismara et al., (2013) Preliminary Findings of a Telehealth Approach to Parent Training in Autism. *Journal of Autism &* *Developmental Disorders, 43*, 2953–2969	Single subject, multiple baseline across parent-child dyads	IV	N=8 Parents of children with ASD, aged 18 to 45 months	1. Self-directed Internet-based learning program 2. Live PC-based 2 way video conferencing and self-guided website 3. 128-bit encrypted software platform.	Findings suggest that telehealth may support parent learning and improve child behaviour for some families who have children with ASD
Adult speech and language disorders					
Bergquist et al., (2009). The effect of internet-based cognitive rehabilitation in persons with memory impairments after severe traumatic brain injury. *Brain Injury, 23*(10), 790-799. Bergquist et al., (2010). Satisfaction ratings after receiving internet-based cognitive rehabilitation in persons with memory impairments after severe acquired brain injury. *Telemedicine and e-Health, 16*(4), 417-423.	Randomised, crossover controlled trial	II	N = 14 Adults with TBI	1. Cognitive rehabilitation focussed on calendar use (intervention), compared to discussion of past diary entries (control). 2. Customised PC-based instant messaging system 3. Network not reported	No significant differences in memory functioning between intervention and control conditions. Significant improvements in use of compensatory memory strategies in both conditions. No significant differences in satisfaction between conditions

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Adult speech and language disorders					
Bourgeois et al., (2007). The effects of cognitive teletherapy on reported everyday memory behaviours of persons with chronic traumatic brain injury. *Brain Injury*, *21*(12), 1245-1257.	Pseudo-randomised controlled trial	III	N = 38 Adults with TBI	1. Spaced retrieval training (intervention) compared to didactic strategy instruction (control). 2. Telephone call for both conditions 3. Network not reported	Spaced retrieval training by phone produced more treatment goal mastery than didactic strategy instruction by phone. No significant differences between groups on generalised strategy use or quality of life.
Brennan et al., (2004). The effect of videoconference-based telerehabilitation on story retelling performance by brain-injured subjects and its implications for remote speech-language therapy. *Telemedicine and e-Health*, *10*(2), 147-154	Randomised, crossover repeated measures study	III	N = 40 Adults with stroke & TBI	1. Two story sets from Story Retell Procedure (SRP). Scored using %IU. Satisfaction ratings 2. PC-based videoconferencing 3. 10 Mbps LAN	No significant differences between FTF and telepractice. Variable such as age, education, technology experience, and gender did not significantly impact differences between telepractice and FTF.
Constantinescu et al., (2010). Assessing disordered speech and voice in Parkinson's disease: a telerehabilitation application. *International Journal of Language and Communication Disorders, 45(6)*, 630-644	Randomised simultaneous assessment (SLP & participant).	III	N = 61 Adults with PD	1. Acoustic and perceptual assessment of dysarthria and voice in PD, satisfaction ratings 2. Customised PC-based videoconferencing with store and forward capabilities 3. 128kbit/s IP	For majority of parameters comparable levels of agreement between telepractice and FTF. Telepractice assessment of dysarthria and voice in PD generally valid and reliable
Dechene et al., (2011). Simulated in-home teletreatment for anomia. International Journal of Telerehabilitation, 3(2), 3-10.	Pre/post -intervention case series study	IV	N = 3 Adults with stroke	1. Lexical treatment tasks using black and white line drawings. 2. Customised PC-based videoconferencing. Touch screen at client end. 3. 600kbit/s	Improvements to confrontation naming for trained items. High client satisfaction.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Adult speech and language disorders					
Forducey et al., (2012). Telehealth for persons with severe functional disabilities and their caregivers: facilitating self-care management in the home setting. *Psychological Services, 9*(2), 144-162.	Randomised crossover trial	II	N = 15 Adults with ABI	1. Cognitive rehabilitation focussed on calendar use compared to waitlist control 2. Customised PC-based instant messaging system 3. Network not reported	Significant differences between intervention and control groups in independent functioning
Georgeadis et al., (2004). Telerehabilitation and its effect on story retelling by adults with neurogenic communication disorders. *Aphasiology, 18*(5-7), 639-652	Randomised, crossover repeated measures study	III	N = 40 Adults with stroke & TBI	1. Two story sets from Story Retell Procedure (SRP). Scored using %IU. Satisfaction ratings 2. PC-based videoconferencing 3. 10 Mbps LAN	No significant differences between FTF and telepractice. High levels of client acceptance of telepractice
Goldberg et al., (2012). Script training and generalization for people with aphasia. *American Journal of Speech Language Pathology, 21* (*3*), 222-238.	Pre/post-intervention case series study	IV	N = 2 Adults with stroke	1. Two personally relevant scripts for each client. 2. PC-based videoconferencing (Skype) 3. Network not reported	Script training is feasible via videoconferencing when supported with FTF sessions.
Hill et al., (2006). An Internet-based telerehabilitation system for the assessment of motor speech disorders: a pilot study. *American Journal of Speech Language Pathology, 15*(1), 45-56.	Counterbalanced repeated measures design. SLP randomised	III	N = 19 Adults with stroke, TBI, PD, surgery, ABI	1. Frenchay Dysarthria Assessment, ASSIDS 2. Customised PC-based videoconferencing with store and forward capabilities 3. 128kbit/s IP	Assessment is feasible, but several ratings on FDA not comparable between environments.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Adult speech and language disorders					
Hill et al., (2008). The effects of aphasia severity on the ability to assess language disorders via telerehabilitation. *Aphasiology, 23*(5), 627-642	Randomised simultaneous assessment (SLP & participant randomised).	III	N = 32 Adults with stroke & TBI	1.BDAE-3 short form, BNT, satisfaction. 2. Customised PC-based videoconferencing with store and forward capabilities. Touchscreen at client end. 3. 128kbit/s IP	Severity of aphasia does not impact accuracy of assessment on BDAE-3. Severity of aphasia did affect ability to assess naming and paraphasia clusters (BNT) via telepractice
Hill et al., (2009a). The redesign and re-evaluation of an internet-based telerehabilitation system for the assessment of dysarthria in adults. *Telemedicine and* *e-Health, 15*(9), 840-850	Randomised simultaneous assessment. (SLP & participant randomised).	III	N = 24 Adults with stroke & TBI	1. Informal oromotor and perceptual assessment, ASSIDS, satisfaction ratings 2. Customised PC-based videoconferencing with store and forward capabilities 3. 128kbit/s IP	Valid and reliable assessment of dysarthria. High client satisfaction
Hill et al., (2009b). Using telerehabilitation to assess apraxia of speech in adults. *International Journal of Language and Communication Disorders, 44*(5), 731-747	Randomised simultaneous assessment. (SLP & participant randomised).	III	N = 11 Adults with stroke & TBI	1. ABA-2, satisfaction ratings 2. Customised PC-based videoconferencing with store and forward capabilities 3. 128kbit/s IP	Valid assessment of apraxia of speech via telepractice is feasible
Kurland et al., (2014). iPractice: Piloting the effectiveness of a tablet-based home practice program in aphasia treatment. *Seminars in Speech and Language, 35* (*1*), 51-63.	Pre/post-intervention case series study.	IV	N = 8 Adults with stroke	1. Black and white line drawings used to create interactive object and action naming books using iBooks Author software. 2. Tablet-based videoconferencing using GoToMeeting app. 3. Network not reported	Home practice enabled maintenance and improvement of naming gains made during a 2-week FTF language treatment program. High client satisfaction, however only 5 of 8 participants completed the home practice program.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Adult speech and language disorders					
Man et al., (2006). A randomised controlled trial study on the effectiveness of a tele-analogy-based problem-solving programme for people with acquired brain injury. *Neurorehabilitation, 21* (*3*), 205-217. Man et al., (2006b). Self-efficacy outcomes of people with brain injury in cognitive skill training using different types of trainer-trainee interaction. *Brain Injury*, *20*(9), 959-970	Double blinded randomised controlled trial across four groups	II	N = 103 Adults with ABI	1. Computer-assisted skill training program for solving problems using analogies. 2. PC-based videoconferencing using Microsoft NetMeeting. 3. Broadband connection	Improvements to problem-solving skills in online environment comparable to outcomes of FTF environment and computer-assisted environment. High level of participant acceptance of telepractice delivery. The FTF clinician-directed training group had a statistically significant improvement in generic problem-solving self-efficacy whereas the other two groups did not.
Mortley et al., (2004). Effectiveness of computerised rehabilitation for long-term aphasia: a case series study. *British Journal of General Practice, 54,* 856-857	Pre/post-intervention case series study	IV	N = 7 Adults with stroke	1. A range of electronic word retrieval therapy tasks. 2. StepByStep© software loaded onto client and clinician PCs enabled transfer of client results and updates of therapy tasks to occur remotely 3. 56K modem (no other details reported)	Improvements to word retrieval skills. Participants reported intensive use of the system and a high degree of independence and satisfaction.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Adult speech and language disorders					
Ng et al., (2013). Telerehabilitation for addressing executive dysfunction after traumatic brain injury. *Brain Injury*, 27(5), 548-564.	Case series	IV	N=3 Adults with TBI	1. Metacognitive intervention applied to participant-selected goals 2. Videoconferencing using Skype 3. High speed internet	Videoconferencing was feasible for implementing this approach. There were trends towards fewer symptoms of executive dysfunction and greater community integration.
Palsbo, S. E. (2007). Equivalence of functional communication assessment in speech pathology using videoconferencing. *Journal of Telemedicine and Telecare*, 13(1), 40-4	Randomised, double-crossover agreement study. SLP not randomised	III	N = 24 Adults with stroke	1. Functional communication measures of motor speech, spoken language expression and spoken language comprehension 2. Hardware videoconferencing. 3. 384 kbit/s IP	Equivalency between telepractice and FTF assessment of functional communication.
Parmanto, et al., (2013). An integrated telehealth system for remote administration of an adult autism assessment. *Telemedicine and e-Health*, 19(2), 88-94.	Case series	IV	N = 10 Adults with ASD	1. Autism Diagnostic Observation Scale 2. Customised PC-based videoconferencing with multiple remote-controlled cameras. Tablet for stimulus presentation to patient 3. 5MB/s Internet	Administration of the assessment was feasible and rated highly by clinicians and patients.
Riegler et al., (2013). Cognitive intervention results in web-based videophone treatment adherence and improved cognitive scores. *Medical Science Monitor, 19*, 269-275	Matched-subject case-control study	III	N = 12 Adults with TBI	1. MOPS-VI (Military On-Line Problem Solving Videophone Intervention) cognitive treatment. 2. Videoconference phone and PC 3. wireless Internet (no other details reported)	67% adherence to intervention. Improvements to memory and learning. No significant difference between FTF and web-based videophone treatment groups.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Adult speech and language disorders					
Sander et al., (2009). A Web-Based Videoconferencing Approach to Training Caregivers in Rural Areas to Compensate for Problems Related to Traumatic Brain Injury. *The Journal of Head Trauma Rehabilitation, 24*(4), 248–261.	Case series	IV	N = 15 Adults with TBI	1. Education and problem solving program for caregivers 2. PC-based videoconferencing 3. Commercial high-speed internet connection	Participants reported overall satisfaction, comfort, perceived they had gained knowledge and at follow-up reported having used knowledge to help deal with problems.
Schoenberg et al., (2008). Comparison of functional outcomes and treatment cost between computer-based cognitive rehabilitation teletherapy program and face-to-face rehabilitation program. *Prof Psych: Research Practice, 39(*2), 169-175	Case-control study	III	N=39 Adults with TBI	1. A range of electronic therapy tasks targeting attention, reaction time, visuospatial, learning, memory and problem solving skills. 2. PC loaded with CRI/PPS Teletherapy System containing therapy exercises and allowed transfer of results and updates of tasks to occur remotely 3. Network not reported	No significant difference between FTF and teletherapy groups for functional outcomes. Similar total cost for FTF and teletherapy programs.
Soong et al., (2005). A pilot study on the effectiveness of tele-analogy-based problem-solving training for people with brain injuries. *International* *Journal of Rehabilitation Research, 28* (*4*), 341-347.	Pilot randomised controlled trial	II	N = 15 Adults with ABI	1. Problem-solving intervention program administered via online vs. computer-assisted programme vs. therapist-administered program. 2. Computer software or online program with videoconferencing 3. Network not reported	Similar improvements to problem-solving skills and self-efficacy for all three conditions.
Theodoros et al., (2008). Assessing acquired language disorders in adults via the Internet. *Telemedicine and e-Health, 14*(6), 552-559	Randomised simultaneous assessment. Participants and SLP randomised	III	N = 32 Adults with stroke & TBI	1. BDAE-3, BNT, satisfaction ratings 2. Customised PC-based videoconferencing with store and forward capabilities. Touchscreen at client end. 3. 128kbit/s	Valid and reliable assessment of aphasia to determine type and severity of aphasia. High client satisfaction

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Adult speech and language disorders					
Turkstra et al., (2011). In-person versus telehealth assessment of discourse ability in adults with traumatic brain injury. *The Journal of Head Trauma Rehabilitation, 27* (6), 424-432.	Randomised, crossover repeated measures study	III	N = 20 Adults with TBI	1. Conversation, picture description, story-generation and procedural description tasks 2. PC-based videoconferencing with store and forward capabilities 3. 512kbit/s	No significant differences between FTF and telepractice.
Fluency – Adults and adolescents who stutter					
Carey et al., (2010). Randomized controlled non-inferiority trial of a telehealth treatment for chronic stuttering: the Camperdown Program. *International Journal of Language and Communication Disorders, 45*, 108-120.	Randomised controlled trial	II	N = 40 Adults who stutter	1. Camperdown Program 2. Telephone: mobile or fixed line Fixed line telephone voicemail service for participant recordings 3. Mobile and fixed line telephone networks	Telephone delivery of Camperdown Program as efficacious as in-clinic delivery. Telehealth significantly more efficient than in-clinic and participants were satisfied with service delivery method.
Carey et al., (2012). Webcam delivery of the Camperdown Program for adolescents who stutter: a phase I trial. *Language, Speech and Hearing Services in Schools, 43*, 370-380.	Case series	IV	N = 3 Adolescents who stutter	1. Camperdown Program 2. Personal computer, webcam, Skype, Audacity (audio recording program). SLP used Pamela for Skype (audio and video recording program) 3. SLP – Internet using broadband	Home-based videoconferencing using personal computers and webcams efficacious, efficient and appealing. Similar time required as telephone delivered treatment.
O'Brian et al., (2008). Telehealth delivery of the Camperdown Program for adults who stutter: a phase I trial. *Journal of Speech Language and Hearing Research, 51*, 184-195.	Case series	IV	N =10 Adults who stutter	1. Camperdown Program 2. Telephone: mobile or fixed line Fixed line telephone voicemail service for participant recordings 3. Mobile and fixed line telephone networks	Telepractice delivery of Camperdown Program effective in reducing stuttering in some adults who stutter. Reduced clinical hours compared with in-clinic delivery.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Fluency – Children who stutter					
Bridgman et al., (2014). Webcam preschool stuttering treatment: outcomes and experiences from a clinical trial. *Paper presented at the 10th Oxford Dysfluency Conference, Oxford, United Kingdom*.	Randomised controlled trial	II	N = 49 Children who stutter (aged: 3 to 5;11)	1. Lidcombe Program 2. Personal computer, webcam, webcam software not specified 3. Internet. No further details reported	Lidcombe Program delivered using home-based videoconferencing comparable to standard in-clinic delivery. No difference between groups for %SS at 9mths and 18mths post randomisation. No difference between groups for number of SLP consultations to complete Stage I.
Lewis et al., (2008). A phase II trial of telehealth delivery of the Lidcombe Program of early stuttering intervention. *American Journal of Speech-Language Pathology, 17*, 139-149.	Randomised controlled trial.	II	N = 22 Children who stutter (aged: 3 to 6 years)	1. Lidcombe Program, parent training audio and video recordings, information sheets 2. Telephone and email 3. Telephone using a toll free number. No further details reported	Telephone delivery of Lidcombe Program viable and effective. More SLP consultations required than standard in-clinic.
O'Brian et al., (2014). Webcam delivery of the Lidcombe Program for early stuttering: a phase I clinical trial. *Journal of Speech, Language and Hearing Research, 57*, 825-830.	Case series Pre-test/post-test	IV	N = 3 Children who stutter (aged: 3;6 , 4;3 , 4;9)	1. Lidcombe Program 2. Personal computer, webcam, webcam software (not specified) 3. Broadband Internet.	Webcam delivery of the Lidcombe Program viable and efficacious. Based on three participants. More SLP consultations were required than standard in-clinic but fewer consultations than reported for telephone delivery.
Wilson et al., (2004). Telehealth adaptation of the Lidcombe Program of early stuttering intervention: five case studies. *American Journal of Speech-Language Pathology, 13*, 81-93.	Series of case studies	IV	N = 5 Children who stutter (aged: 3; 5 to 5;7)	1. Lidcombe Program, parent training audio and video recordings, information sheets 2. Telephone 3. Network not reported	Telephone delivery of Lidcombe Program viable and effective. Parents expressed satisfaction with telepractice delivery of Lidcombe Program. More SLP consultations required than standard in-clinic.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Voice disorders					
Constantinescu et al., (2010). Assessing disordered speech and voice in Parkinson's disease: a telerehabilitation application. *International Journal of Language and Communication Disorders, 45*(6), 630-644	Randomised simultaneous assessment. SLP also randomised	III	N = 61 Adults with Parkinson's Disease	1. Acoustic and perceptual assessment of dysarthria and voice, satisfaction ratings 2. Customised PC-based videoconferencing with store and forward capabilities 3. 128kbit/s IP	For majority of parameters comparable levels of agreement between telepractice and FTF. Telepractice assessment of dysarthria and voice in Parkinson's disease generally valid and reliable
Constantinescu et al., (2011). Treating disordered speech and voice in Parkinson's disease online: a randomized controlled non-inferiority trial. *International Journal of Language and Communication Disorders, 46* (*1*), 1-16	Randomised controlled non-inferiority trial	II	N = 34 Adults with Parkinson's disease	1. Lee Silverman Voice Treatment (LSVT®LOUD) 2. Customised PC-based videoconferencing with store and forward capabilities 3. 128 kbit/s	Non-inferiority of online LSVT®LOUD confirmed. High client satisfaction
Howell et al., (2009). Delivering the Lee Silverman Voice Treatment (LSVT) by web camera: a feasibility study. *International Journal of Language and Communication Disorders, 44* (*3*), 287-300	Case-control study	III	N = 17 Adults with Parkinson's Disease	1. Lee Silverman Voice Treatment (LSVT®LOUD). 2. Internet-based videoconferencing with voice recording and sound level meter capabilities. 3. Broadband internet connection (no other details reported)	LSVT is feasible via videoconferencing. Comparable gains for telepractice and FTF environments.
Towey, M P. (2012). Speech Therapy Telepractice for Vocal Cord Dysfunction (VCD): MaineCare (Medicaid) Cost Savings. *International Journal of Telerehabilitation, 4* (1), 33-36.	Cost comparison to previous month of treatment	IV	N = 7 Adults with vocal cord dysfunction	1. Waldo County General Hospital standard vocal cord dysfunction treatment protocol. 2. Not reported 3. Not reported	Comparison between telepractice delivery of services to previous month of in person delivery of services to same clients revealed a 72% cost reduction.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Dysphagia					
Malandraki et al., (2012). Teledynamic evaluation of oropharyngeal dysphagia. *Journal of Speech, Language, and Hearing Research*, *54*, 1497-1505.	Prospective cohort study, no control group. Compared recorded ratings of two VFSS studies per patient directed consecutively in online and FTF method	III	N=32 Adults with dysphagia	1. Assessed a) severity of dysphagia, b) Penetration-Aspiration Scale, c) clinician treatment recommendations 2. Used Teledynamic Software System connected to hospital fluoroscopy machine. 3. Broadband Internet. No network speed specified.	Analysis of the recorded VFSS images showed overall good agreement in subjective severity ratings, Penetration-Aspiration scale ratings. Moderate to high agreement for treatment recommendations. Technical and operational issues impacting on the feasibility and accuracy of online VFSS administration and interpretation were reported.
Malandraki et al., (2013). An international pilot study of asynchronous teleconsultation for oropharyngeal dysphagia. *Journal of Telemedicine and Telecare*, *19*, 75-79.	Prospective study, no control group. Compared ratings of recorded VFSS studies and treatment plans of novice dysphagia clinician (Greece) and expert SLP (USA).	III	N = 17 Adults with dysphagia at hospital in Greece	1. VFSS recorded at 14 frames per second (fps) at hospital in Greece 2. Website utilized to store patient information, case histories VFSS recordings. VFSS images were stored using a compression codec WMV9 and rated on a PC using standard video software. 3. No network details provided	Teleconsultation model was effective in preventing substandard decisions in >50% of patients assessed when comparing decisions of the novice dysphagia clinician in comparison to the decisions of the specialist dysphagia clinician

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Dysphagia					
Sharma et al., (2011) Assessing swallowing disorders online: A pilot telerehabilitation study. *Journal of Telemedicine and eHealth*, 17(9), 688-695.	Prospective cohort study with control group. Simultaneous assessment with SLP randomised.	III	N = 10 Standardised adult patients portraying 2 each of normal, and simulated mild, moderate and severe dysphagia	1. Performed CSE and determined levels of agreement between diagnostic decisions for FTF & online clinicians. 2. Customised videoconferencing system with additional capabilities (store and forward; free standing zoom capable webcamera, lapel microphone). Modifications incorporated into the CSE protocol to assist online assessment. 3. Wireless network, 128kbit/s	Found high levels of agreement between online and FTF decisions across all aspects of the clinical swallow assessment, clinical decisions and recommendations.
Ward et al., (2012). Validity of conducting clinical dysphagia assessments for patients with normal to mild cognitive impairment via telerehabilitation, *Dysphagia*, 27, 460-472.	Prospective cohort study with control group. Simultaneous assessment with SLP randomised.	III	N=40 Adults with dysphagia with normal to mild cognitive impairment.	1. Assessed levels of agreement between diagnostic decisions from simultaneous FTF and online assessments performed CSE 2. Customised videoconferencing system with store and forward capabilities. 3. Wireless network, 128kbit/s	Clinically acceptable levels of agreement found between online and FTF decisions across: oral, oromotor, and laryngeal function; food and fluid trials; aspiration risk and clinical management decisions using Dysphagia Outcome Severity Scale ratings.
Ward et al., (2014). Impact of dysphagia severity on clinical decision making via telerehabilitation. *Telemedicine and e-Health,* 20 (4), 296-303.	Prospective cohort study with control group. Simultaneous assessment with SLP randomised.	III	N=100 Adults with dysphagia comprising of four matched groups of 25 patients	1. Assessed levels of agreement between diagnostic decisions from simultaneous FTF and online assessments performed CSE across four severity levels 2. Customised videoconferencing system with store and forward capabilities. 3. Wireless network, 128kbit/s	Comparable levels of agreement across all severity groups were observed between raters for decisions regarding oral versus non-oral intake, and safe food/fluid consistencies. Over 90% agreement achieved on CSE items. Greater support from assistant at patient end was required for those patients with increased complexity.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Craniofacial and Head & Neck Disorders					
Burns et al., (2012). A pilot trial of a speech pathology telehealth service for head and neck cancer patients. *Journal of Telemedicine and Telecare. 18,* 443-446	Case series Description of clinical service	IV	N = 38 Adults with head and neck cancer: laryngectomy & non-laryngectomy	1. Clinical support provided via telepractice by specialist cancer service to patients/clinicians at regional cancer site 2. Videoconferencing unit with medical camera system 3. Health Department's Telehealth service using IP at 1 Mbit/s	50 sessions conducted. All clinical problems managed successfully via telehealth. High levels of patient and clinician satisfaction.
Glazer et al., (2011). Multidisciplinary care of international patients with cleft palate using telemedicine. *Archives of Facial Plastic Surgery, 13,* 436-438.	Case series with pre-test/post-test design.	IV	N=10 Children aged 3-17 years with VPI and speech disorder secondary to cleft palate repair.	1. Two or three monthly treatment sessions: Spanish Interpreter was used. 2. PC-based videoconferencing (WebEx) 3. IP, bandwidth not stated	Improvement in voice quality and speech intelligibility. Significant improvement in whole word, initial consonant and total scores, but not for final consonants and sound ratios. Significant improvement on some areas of Quality of Life scale.
Ward et al., (2007). Assessment of communication and swallow function post laryngectomy: A telerehabilitation trial, *Journal of Telemedicine and Telecare*, 13(3), 88-91.	Prospective cohort study with control group. Simultaneous assessment with SLP randomised.	III	N = 20 Adults with Laryngectomy	1. Compared diagnostic decisions from simultaneous FTF and online assessments of oromotor, swallowing and communication using structured script 2. Custom built videoconferencing unit with and additional capabilities (store and forward). 3. 128 kbit/s	Found acceptable levels of agreement between online and FTF ratings for oromotor, speech and swallowing clinical decisions, but issues with limited vision from fixed web cameras. Clinicians reported reduced satisfaction. Patient satisfaction was high.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Craniofacial and Head & Neck Disorders					
Ward et al., (2009). Assessment of communication and swallowing post-laryngectomy: A telerehabilitation trial, *Journal of Telemedicine and Telecare*, 15 (5), 232-237.	Prospective cohort study with no control group. Simultaneous assessment.	III	N=10 Adults with Laryngectomy	1. Compared diagnostic decisions from simultaneous FTF and online assessments of communication, swallowing and stoma status assessed alaryngeal speech and swallowing 2. Custom built videoconferencing units with store and forward and additional capabilities. 3. 3G phone network – maximum throughput 3 Mbit/s	Acceptable levels of agreement between online and FTF ratings for oromotor, speech, swallowing and stoma status. Clinicians and patients reported high satisfaction.
Whitehead et al., (2012). Telemedicine as a means of effective speech evaluation for patients with cleft palate. *Annals of Plastic Surgery, 68,* 415- 417.	Simultaneous assessment and satisfaction survey.	III	N=9; Children aged 5-14 years with surgical cleft palate repair.	1. Informal protocol measured oral pressure, resonance and articulation; Medida Espanola de Articulacion (MEDA) test and standardised articulation test and satisfaction. 2. Hardware videoconferencing 3. Dedicated Internet line	No statistically significant difference between assessment methods. High family satisfaction.
Hearing Impairment					
Blaiser et al., (2013). Measuring costs and outcomes of tele-intervention when serving families of children who are deaf/hard-of-hearing. *International Journal of Telerehabilitation, 5* (2), 3-10.	Randomised control trial Random allocation with children in each group being matched on several criteria.	II	N=27 Families of infants and toddlers with hearing impairment	1. Parent-Infant Program services according to Individualized Family Service Plan; mean of 2 visits/ month for 6 months; 1 visit was via telepractice, the other was in-person. 2. Two-way PC videoconferencing; 3. IP of various bandwidths; midway through study families with insufficient bandwidth upgraded to minimum of 1.5 Mbps	Telepractice group scored significantly higher on expressive language and significantly better on Parent Engagement subscale. Cost savings of telepractice increased as intensity of service delivery increased. Provider and family satisfaction was positive overall, but there was variability in opinions.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Hearing Impairment					
Constantinescu, G. (2012). Satisfaction with telemedicine for teaching listening and spoken language to children with hearing loss. *Journal of Telemedicine and Telecare, 18,* 267-272.	Cohort study measuring treatment satisfaction	IV	N=18; 13 families + 5 therapists	1. Auditory-Verbal Therapy 2. PC-based videoconferencing (Skype) 3. High-speed broadband	Parents and therapists generally expressed high satisfaction across all domains. All parents felt that interaction via telepractice was at least as comfortable as FTF interaction and they were at least as satisfied as they would be with FTF treatment.
Constantinescu et al., (2014). A pilot study of telepractice delivery for teaching listening and spoken language to children with hearing loss. *Journal of Telemedicine and Telecare. 20,* 135-140.	Retrospective cohort study with matched controls	III	N=14 Children with bilateral hearing impairment.	1. Auditory-Verbal Therapy 2. PC-based videoconferencing (Skype) 3. Broadband IP	No significant differences between e-AVT and FTF groups on language scores 2 years post-optimal amplification. Overall, the E-AVT group scored within the normal range for children with normal hearing on the language test.
Davis et al., (2012). Maximizing the impact of telepractice through a multifaceted service delivery model at the Shepherd Centre, Australia. *The Volta Review, 112,* 383-391.	Non-experimental descriptive study	IV	N=45 Children and families with hearing impairment.	1. Auditory-Verbal Therapy 2. PC-based videoconferencing (Skype) 3. IP, bandwidth not stated	47% of children achieved Total Language Scores within the average range or above. These children had been diagnosed and fitted with hearing aids and/or cochlear implants before 12 months of age and had highly engaged patients.
Lalios, A.P. (2012). Connect*Hear* teleintervention program. *The Volta Review, 112*, 357-364.	Non- experimental descriptive study of treatment satisfaction	IV	N=11 Families consisting of 13 individuals with hearing loss	1. Auditory-Verbal Therapy 2. Various hardware including PCs, laptops, portable devices and software including Skype and iChat; 3. Various IP, including wired, wireless and satellite.	All parents observed that their child had made progress through telepractice intervention and all reported high satisfaction with the program.

Study	Study design	NHRMC level	Sample	1. Materials 2. Technology 3. Network	Findings
Clinical supervision and professional mentoring					
Burns et al., (2012). A pilot trial of a speech pathology telehealth service for head and neck cancer patients. *Journal of Telemedicine and Telecare. 18,* 443-446	Case series Description of clinical service	IV	N = 38 Adults with head and neck cancer: laryngectomy & non-laryngectomy	1. Clinical support provided via telepractice by specialist cancer service to patients/clinicians at regional cancer site 2. Videoconferencing unit with medical camera system 3. Health Department's Telehealth service using IP at 1 Mbit/s	50 sessions conducted. All clinical problems managed successfully via telehealth. High levels of patient and clinician satisfaction.
Carlin et al., (2012). Promising practices in e-supervision: Exploring graduate speech-language pathology intern's perceptions. *International Journal of Telerehabilitation, 4* (2), 25-38	Mixed-methodology study comparing perceptions of e-supervision with in-person supervision	IV	N= 100 SLP interns of these, 7 were selected for the e-supervision program	1. Direct supervision of clinical practice at least 4 hours a week + indirection supervision/ mentoring at least 2.5 hours per week. 2. PC-based videoconferencing (Skype), Instant Messaging & email 3. IP, bandwidth not stated	E-Supervision enabled supervision of the interns with a variety of clients and conducting a variety of professional activities, similar to FTF supervision. It was perceived as less stressful and more convenient to conventional supervision.
Carlin et al., (2013). The use of e-supervision to support speech –language pathology graduate students during teaching practica. *International Journal of Telerehabilitation, 5* (2), 21-31.	Mixed-methodology	IV	N=13 2nd year graduate students enrolled in an SLP program.	1. University liaison supervisor observed student 4-5 times/ semester and conducted at least two follow-up meetings with the student and cooperating SLP supervisor, 2. PC-based videoconferencing mainly used. Teleconferencing and email also used. 3. IP, bandwidth not stated	Students perceived that they received adequate supervision, feedback, support and communication. Additional benefits to students, children on caseload and universities were noted, but also some disadvantages such as the inability to view all work contexts.

Abbreviations:

NHMRC = National Health & Medical Research Council; RCT = Randomised Controlled Trial; ASD = Autism Spectrum Disorder; TBI = Traumatic Brain Injury; ABI = Acquired Brain Injury; PD = Parkinson's disease; SLP = Speech Language Pathologist; PC = Personal Computer; FTF = Face-to-Face; ASHA = American Speech and Hearing Association; REEL-3 = Receptive-Expressive Emergent Language Test, Third Edition; SKOLD = Screening Kit of Language Development; PLS-4 = Preschool Language Scale -4; GFTA-2 = Goldman-Fristoe Test of Articulation, Second Edition; PPVT-III = Peabody Picture Vocabulary Test, Third Edition; CELF®-4 = Clinical Evaluation of Language Fundamentals® - Fourth Edition; EOWPVT-4 = Expressive One-Word Picture Vocabulary Test – 4; CELF-3 = Clinical Evaluation of Language Fundamentals 3; QUIL = Queensland University Inventory of Literacy; NEALE = Neale Analysis of reading ability; SAST = South Australian Spelling Test; ADOS = Autism Diagnostic Observation Scale; BNT = Boston Naming Test; BDAE-3 = Boston Diagnostic Aphasia Examination, 3rd Edition; ABA-2 = Apraxia Battery for Adults, 2nd Edition; ASSIDS = Assessment of Intelligibility of Dysarthria Speech ; IP = Internet Protocol; T1 = Transmission System 1; 3G = Third Generation; CSE = Clinical Swallowing Examination; VPI = Velopharyngeal insufficiency; FCT = Functional Communication Training; USA = United States of America; UAE = United Arab Emirates.