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RESEARCH ARTICLE

Speech-language pathology teletherapy in rural and remote educational settings: Decreasing service inequities

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Abstract

Purpose: The objectives of this study were to investigate the efficacy of a speech-language pathology teletherapy program for children attending schools and early childcare settings in rural New South Wales, Australia, and their parents' views on the program's feasibility and acceptability.
Method: Nineteen children received speech-language pathology sessions delivered via Adobe Connect®, Facetime© or Skype© web-conferencing software. During semi-structured interviews, parents ($n = 5$) described factors that promoted or threatened the program's feasibility and acceptability.
Result: Participation in a speech-language pathology teletherapy program using low-bandwidth videoconferencing improved the speech and language skills of children in both early childhood settings and primary school. Emergent themes related to (a) practicality and convenience, (b) learning, (c) difficulties and (d) communication.
Conclusion: Treatment outcome data and parental reports verified that the teletherapy service delivery was feasible and acceptable. However, it was also evident that regular discussion and communication between the various stakeholders involved in teletherapy programs may promote increased parental engagement and acceptability.

Keywords: *Speech-language pathology, teletherapy, telehealth, school, rural*

Introduction

Across the globe there are significant inequities between rural and urban populations in accessing health services. The opportunity to receive healthcare speedily, conveniently, adequately and at an affordable cost can be vastly different depending on place of residence (Dew et al., 2012). Dew et al. (2013) found that this service inequity extends to the availability of all allied health services. There are insufficient therapy services to meet identified needs, compared to metropolitan areas. The proportion of health professionals living and working in rural and remote areas is much lower than the proportion living in metropolitan areas (World Health Organization, 2011). In Australia, Lambier and Atherton (2003) found that 34% of the population reside in rural and remote areas, but only 3.9% of Australia's speech-language pathologists (SLPs) are primarily employed in these areas. In 2014, per 100 000 of the population there were 25.9 speech speech-language pathologists in major cities, 20.5 in inner regional areas, 16.9 in outer regional, 12.7 in

remote and 5.9 in very remote areas (Workforce Australia, 2014).

Inequities in access to health services have a consequent cost to individuals, families and communities. Early and ongoing access to therapy has been shown to facilitate children's participation in family and local community activities (Veitch et al., 2012) and to reduce societal costs by increasing the likelihood of families engaging with less-expensive mainstream health and education services (Guralnick, 2001). These outcomes have been replicated in the Australian context by several studies of multidisciplinary early intervention programs (Ziviani, Feeney, Rodger, & Watter, 2010). Early intervention enhances quality-of-life for both people and carers, regardless of the age of the healthcare consumer (Dew et al., 2012).

Service inadequacies in rural areas also relate to the availability of SLPs. Shortages in the rural speech-language pathology (SLP) workforce have been reported even in advanced economies with relatively extensive government and privately funded health systems, such as the US (Scheideman-Miller

et al., 2002) and Australia (Lambier & Atherton, 2003). The majority of Australian families requiring the services of SLPs have been reported to experience significant barriers to accessing services (O'Callaghan, McAllister, & Wilson, 2005), but accessibility inequities are more pronounced in rural and remote areas of Australia.

Tyranny of distance in SLP service delivery

Travel is a significant issue for children, parents/carers and clinicians in accessing and providing speech-language pathology services in rural areas. Children who travel long distances to services can become fatigued and less attentive during assessment and therapy sessions (Scheideman-Miller et al., 2002), while missing whole days of school. Parents/carers may incur significant transport costs and need time away from employment or from other responsibilities (Theodoros & Russell, 2008). SLPs who travel long distances to provide services can consequently also experience fatigue and have limited time available for therapy sessions in visited rural communities or make infrequent or irregular visits that can reduce treatment efficacy (Dew et al., 2013).

Clearly, challenges associated with distance can result in inequity of access to speech-language pathology services for people living in rural and remote communities. The impetus of this study is the need to improve the rural Australian population's access to appropriate, effective paediatric speech-language pathology services through the provision of these services: (1) in communities where they are not present or where the frequency of contact is insufficient to be effective and (2) in ways that are less costly for families, less disruptive and more convenient.

Teletherapy as a potential solution

Telehealth (or teletherapy) has been identified as a model of service delivery that has the potential to overcome barriers of access to services (Hill & Miller, 2012; Theodoros, 2011). *Telehealth, teletherapy, telepractice, telerehabilitation, telemedicine* and *telecare* are all terms that have been used to describe the application of telecommunications technology to the delivery of speech-language pathology professional services. *Teletherapy* is the term used in this paper, unless direct reference is being made to another publication that uses an alternative term.

SLPs use a wide range of technologies to deliver services at a distance (Hill & Miller, 2012). The development of further evidence for teletherapy's effectiveness, especially for paediatric clients, has been identified as a pre-requisite for its expanded use (Waite, Theodoros, Russell & Cahill , 2010). Historically, most speech-language pathology teletherapy research has focused on services to adult clients and on assessment of swallowing, speech and language skills (Fairweather, Parkin, & Rozsa, 2004; Reynolds, Vick, & Haak, 2009; Theodoros, 2008).

Speech-language pathology teletherapy literature

In a review of the speech-language pathology teletherapy, or "telepractice" literature, Edwards, Stredler-Brown, and Todd (2012) found that teletherapy is an effective way to diagnose and treat children and adults and that, in general, services delivered in a traditional face-to-face setting or by teletherapy resulted in similar outcomes. Teletherapy applications have been used in the assessment and treatment of a wide range of speech and language disorders, including articulation disorders (Crutchley, Dudley, & Campbell, 2010), autism (Parmanto, Pulantara, Schutte, Saptono, & McCue, 2013), dysarthria (Hill et al., 2006), stuttering (Carey, O'Brian, Onslow, Packman, & Menzies, 2012), language and cognitive disorders (Waite et al., 2010), dysphagia (Malandraki, McCullough, He, McWeeny, & Perlman, 2011) and voice disorders (Towey, 2012).

In the US, schools are currently the most common setting in which speech-language pathology teletherapy services are delivered (American Speech-Language-Hearing Association (ASHA), 2012). ASHA noted that this has been driven by distances between schools in rural districts, shortages or maldistribution of clinicians, and opportunities to offer greater specialisation of services (American Speech-Language-Hearing Association, 2012). Similar concerns in Australia regarding both equity of access and efficiency appear to have provided an increasing impetus to seek teletherapy solutions in schools and early childcare settings. To date, however, systematic data is lacking as to where and how speech-language pathology teletherapy is being utilised in Australia.

According to ASHA (2012), the effectiveness of teletherapy or telepractice as a service delivery model in schools is well documented. In a seminal study, Scheideman-Miller et al. (2002) described the introduction of a teletherapy service into rural schools for students with articulation and language difficulties. They used a parent, teacher and clinician perceptual rating scale and found that, after 5 weeks of video-conferenced therapy sessions, students made significant improvement from pre- to post-intervention in the areas of social interaction, problem-solving and memory. Recent research has compared child outcomes from interventions for articulation, language and/or fluency disorders delivered either through teletherapy or face-to-face in schools (Grogan-Johnson et al., 2010). Further, Grogan-Johnson, Gabel, Taylor, Rowan, Alvares, and Shenker (2011) compared outcomes from an articulation intervention delivered by individual

videoconferenced sessions or face-to-face group sessions. In both the aforementioned studies, children made similar gains in teletherapy interventions compared to face-to-face interventions over similar time periods. Waite, Cahill, Theodoros, Busuttin, and Russell (2006) found similar results for groups of school-age children with articulation disorders in Australia. Taken together, these studies provide strong evidence for the efficacy of teletherapy in school settings. However, the studies have focused on a restricted range of childhood communication difficulties.

Of relevance to the current study, Gabel, Grogan-Johnson, Alvares, Bechstein, and Taylor (2013) investigated the efficacy of speech-language pathology services delivered by teletherapy for a wider range of communication difficulties and disorders. They compared the progress of 71 children who received teletherapy one-to-one with the progress of over 5000 children described in the K-12 Schools National Outcomes Measurement System of the ASHA database (Mullen & Schooling, 2010) who received face-to-face therapy in small groups. They concluded that school-age children with communication disorders could make progress in a teletherapy service delivery model.

Lincoln, Hines, Fairweather, Ramsden, and Martinovich (2014) examined nine clients of a generalist SLP teletherapy program called "Come N See" (CNS), who received a maximum of 12, 30-minute SLP teletherapy sessions on a fortnightly basis. Lincoln et al. found that there was evidence for the efficacy of this program. Moreover, stakeholders indicated that the benefits of teletherapy delivered within the school setting far outweighed any perceived disadvantages.

Limitations in the research literature

As yet, research focusing on a broad base of communication disorders, particularly in regard to children, has an insufficient evidence base for generalist speech-language pathology services. Except for the study of Lincoln et al. (2014), no research located in the context of regular generalist teletherapy programs provided directly into Australian schools has been published. Such research is necessary for any extensive application of this service delivery model to be considered for use in Australia.

Some of the studies of videoconferenced teletherapy in schools have involved utilisation of high bandwidth technology. Research into low bandwidth teletherapy utilising desktop computers in the Australian context is essential if teletherapy is to be considered for extensive use in Australian schools in the immediate future.

Few studies have investigated stakeholder perceptions of teletherapy intervention's feasibility, acceptability and effectiveness (Lincoln et al., 2014). Most qualitative data has been in the form of satisfaction rating scales of teletherapy as a mode of service delivery (Crutchley & Campbell, 2010; McCullough, 2001; Rose, Furner, Hall, Montgomery, Datsavras, & Clarke, 2000; Scheideman-Miller et al., 2002).

Purpose

The objectives of this study were to evaluate the effectiveness, feasibility and acceptability of a teletherapy school-based, low-bandwidth method of delivering speech-language pathology services remotely to children in rural and remote areas. We extend and build on the work of Lincoln et al. (2014) by (a) recruiting a larger sample of children from more remote areas of New South Wales (NSW) in Australia, (b) providing on average less therapy time with the SLP, (c) delivering treatment via multiple SLPs and (d) delivering across a range of settings including early childhood educational settings. We addressed the following research questions:

(1) Did participation in the CNS teletherapy program improve children's speech and language skills after up to six treatment sessions?

(2) What were the views of parents and carers from remote communities of this program's feasibility and acceptability?

Method

Ethics approval

The study was approved by the University of Sydney Human Ethics Committee (ethics clearance 2012/489) on 14 June 2013.

Study design

This study was designed as a group treatment study utilising a mixed method evaluation. Post-intervention quantitative and qualitative data were collected.

Recruitment

All children whose results in the initial and review assessments established the presence of communication skill difficulty were invited to participate in the research. Written information about the research was provided to parents and carers through the staff at the children's early child care settings and schools.

In the 4 weeks before the conclusion of the teletherapy sessions, parents and carers were invited to participate in interviews about their views and experience of the program. Separate consent for participation in the interviews was obtained. The interviews were conducted at the child's school or early childhood setting within 1 day of the child's review assessment. No written or verbal information was supplied regarding the review results prior to or

during the interview. Consent was obtained for 22 children and five parents to participate in the research.

Attrition

Three children were not available at the time of the post-intervention assessment: two were not at school or childcare when the reviews were being conducted and one child declined to be reviewed.

Demographic data

All children and parents participating in this study lived in the Western NSW Local Health District. It is the second most sparsely populated health district in the state of New South Wales (NSW Health, 2015), with just over one person per square kilometre (271 000 people across 250 000 square kilometres in 2013). Of children within the area aged 0–14 years, 16% are identified as Aboriginal, compared with 2.5% of the population of NSW as a whole. The children participating lived in six towns in the district, only one lived in the district's major town (32 300 population), with the other five towns lying between 51 km and 354 km from a major regional centre. The five smaller towns ranged in population from 1200–4540.

The 19 children ranged in age from 3–12 years, averaging 7.8 years. Aboriginal or Torres Strait Islander children made up 47.4% of the child participants. The number of teletherapy sessions ranged from 3–6, with an average of 4.9 sessions. The average number of therapy goals per child was 2.4. Fifteen children received the service across six school sites and the remaining four children across three early childcare sites. Technology used to provide the service was Adobe Connect$^©$ for 13 children (68.4%), Facetime$^©$ for four children (21.1%) and Skype$^©$ for two children (10.5%).

Four of the five parents were female. While ethnicity data were not gathered regarding the parents, none of their children were Aboriginal or Torres Strait Islander. Their children received the speech-language pathology teletherapy services across three government schools. All teletherapy sessions observed were provided through Adobe Connect. The average number of sessions attended by individual parents was 2.2. Four of the interviews were between 21–23 minutes in length and one was of 14 minutes.

Description of the speech-language pathology teletherapy program "Come N See"

Royal Far West, a rural children's health service, commenced a teletherapy program to deliver speech-language pathology services to pre-school and primary school children (from 3–12 years of age) living in rural and remote areas of NSW. The program, CNS, provided face-to-face assessment of

children nominated by their school or pre-school (typically 2 hours in length) through outreach visits. The assessments typically occurred from 1–4 months prior to the commencement of teletherapy. Treatment goals were established via collaboration between the children's parents, caregivers and teachers and the treating SLP. Therapy was provided remotely via low bandwidth videoconferencing with Royal Far West SLPs sited in Sydney. The children were offered therapy blocks of six fortnightly sessions over a 12-week period from mid-March to June 2013. Nine children received six sessions, three children received five sessions and seven children received either three or four sessions due to their absence from school or early childcare setting. The teletherapy block period was followed within 1–4 weeks by face-to-face reviews of the communication areas targeted in teletherapy sessions. The teletherapy sessions supported children with a range of speech and language needs. The SLPs also sought to work remotely with the adults who were supporting the child locally in therapy-related activities and practice. These local adults were either a therapy assistant nominated by the school or early childcare facility, a teacher, an employee of an early intervention service, a volunteer or a parent/caregiver. All families were encouraged before and during the therapy block to have one adult family member at the sessions to observe, participate and discuss home intervention techniques. All sites in the study had a therapy facilitator present, usually a staff member. All but one site agreed to the therapy facilitator doing some practice of the therapy techniques at least once between sessions. Frequently a family member and therapy facilitator were both present. At least one supporting adult was present for the entirety of each session and typically consultation regarding therapy practice was included in the session. Therapy sessions lasted a maximum of 30 minutes. Services were provided to the children in this study by a total of four SLPs.

During teletherapy sessions the SLPs worked with the children on their communication difficulties using digital documents, pictorial materials and verbal and non-verbal interactions. The SLPs converted some of their therapy resources into PDF, PowerPoint and JPG digital formats to be shared on-screen with the remote site and/or emailed to be printed locally for use in the sessions and for practice activities. Online website resources, online games and some CD-ROM resources were utilised in therapy and as rewards.

CNS utilised one of three web-based low bandwidth conferencing platforms (as well as telephone consultations and email). One platform was Adobe Connect$^©$, a web-based conferencing platform, that connected children and one or more accompanying adult in the child's school or pre-school via a web-cam enabled laptop or desktop computer with the SLP at a desktop computer in Sydney. Royal Far

West supplied each participating rural site two headsets with headphones and microphones for use during sessions, recommending the use of two computers side-by-side. Some schools used only one headset and one computer. Before each session, a therapy facilitator selected by the school ensured that the technology was set up appropriately and operational. The second platform was Facetime$^{©}$, connecting the clinician on an iPad in a clinic room at Royal Far West with the child at pre-school or at home via an iPad at the remote site. The third option was Skype$^{©}$ on either camera-enabled computers or iPad.

Quantitative data: Goal attainment scaling

Collection

The effectiveness of the CNS program was evaluated through the collection and analysis of Goal Attainment Scaling (GAS) results. GAS was originally developed for use in the fields of medicine, rehabilitation psychology, education and social work (Smith, 1994). It is a criterion-referenced measure of change, where individualised goals are described within specific ranges of outcomes (King, McDougall, Palisano, Gritzan, & Tucker, 1999). The ratings are made on a 5-point scale for each goal area. Typically, and in this study, a rating of +2 represents a "much more than expected" level of achievement, +1 a "somewhat more than expected" level, 0 an "expected" level, −1 a "somewhat less than expected level" and −2 a "much less than expected" level. Each level is criterion-referenced. Lincoln et al. (2014) used GAS to examine the efficacy of a SLP program, finding 69% of intervention goals for the children in their study were achieved to at least the level expected before therapy commenced.

After training in the creation of GAS (Smith, 1994), each SLP drafted GAS goals for each of their children through collaboration with one or more of the supporting adults in the child's local environment (parent/carer, teacher). Both analysis of the results of recent assessment and the priorities of supporting adults were used in the selection of goal areas. The SLP's judgement as to the likely levels of progress for the number of sessions offered and the presumed practice of activities was used to set the intervals of achievement and define the criterion level for achievement. The first author had a moderating role, reviewing and approving the goals prior to the commencement of interventions to ensure the goals reflected an appropriate expectation of progress, considering the nature of the child's difficulties, the evaluation and the amount of clinician directed intervention offered. Children had between one and four goals set at the commencement of their treatment.

Limitations in the number of sessions provided to some students due to absence from school or the early childhood setting meant that work towards achieving some goals could not be undertaken. Progress on all the goals was reviewed within 4 weeks of the conclusion of the intervention period. The assessment of progress was conducted by a second SLP who was blinded to the child's performance prior to and during intervention. The method and materials for reviewing of targeted skills were determined by the treating SLP and approved by a second experienced SLP. The reviewing SLP assigned a GAS rating for each goal. Accuracy of the post-treatment GAS ratings was verified by a second experienced SLP.

Analysis

The GAS ratings were entered into a spreadsheet (Microsoft Excel®). Both descriptive statistics and summed GAS scores converted to a *t*-score (Lannin, 2003; Turner-Stokes, 2009) were used in the analysis.

Qualitative data: Interviews with parents

Collection

Qualitative data were collected from five semi-structured interviews conducted face-to-face at the child's school. Parents were interviewed by the first author, who had not been involved in the therapy program delivery for these parents' children. Interviews were recorded on two digital voice recorders. The interviews explored parents' perceptions of the advantages and disadvantages of teletherapy and the nature of their satisfaction and dissatisfaction with CNS.

During the semi-structured interview, issues relevant to teletherapy were discussed. Example questions were: In your opinion, what were some of the benefits of using technology to receive therapy services? In your opinion, what were some of the disadvantages of using technology to receive therapy interventions? Do you think your child's communication improved? In your opinion, what do you think worked best for you and your child?

Analysis

The analytical framework for the interview data was thematic content analysis with constant comparison. The constant comparison approach involves an iterative process of constantly comparing data, which can result in the identification of new categories of data and new relationships between data.

The first author listened to the digital recordings of the interviews once each before they were transcribed word-for-word by a professional transcription service. In the typed transcriptions every

word of both interviewer (the first author) and interviewee was transcribed. The first author read the transcripts and checked them against the audio to ensure accuracy. Before the first formal data coding the first author re-read the data corpus and summarised in writing what appeared to be the most salient features from the interviews (Sandelowski, 2000). The initial five stages of data preparation and analysis corresponded to the stages of the qualitative content analysis protocol described by Graneheim and Lundman (2004). There were five stages of the analysis for each interview: (1) Meaning units (i.e. ideas) within the interview text were identified and marked with an individual alphanumeric identifier; (2) Meaning units were condensed into coding nodes; (3) Coding nodes were interpreted and modified to provide consistent wording; (4) Categories were developed through constant comparison of the coding nodes; and (5) Themes and sub-themes were generated through the grouping of categories into major content areas (Graneheim & Lundman, 2004).

Result

Goal attainment

A total of 45 goals (range = 1–4; mean = 2.4 goals) were established for targeting specific areas of communication skills. There were 20 goals for speech sound production skills (44.4% of total goals); 14 for expressive language skills (31.1%); four for receptive language skills (8.9%); five for pragmatic language skills, including communicative engagement and social functions (11.1%); one for phonological awareness skills (2.2%); and one for speech fluency, i.e. stuttering (2.2%). Tables I and II present the children's GAS results for each therapy goal.

Percentages

Thirty-one goals (68.9%) were achieved at either an expected or greater than expected level. Nine goals were at the expected level (i.e. GAS score of 0) and 22 at above the expected level (i.e. GAS score of +1 or +2). For 37 out of 45 goals (82.2%) the children made at least some progress. Of the 19 children, 15 (78.9%) achieved at least one goal at the expected level or beyond it. Eight children (42.1%) achieved all their goals.

A t-score (Lannin, 2003) less than 50 reflects performance below the expected level (overall), 50 reflects an expected level of performance and above 50 reflects performance above the expected level. The children's GAS t-scores ranged from 25–75, with a mean of 53.05 ± 14.60. Four children achieved a t-score of 50 (21.1%), 10 children a t-score above 50 (52.6%) and five children a t-score of below 50 (26.3%). Therefore, 73.68% of the

Table I. Goal Attainment Scaling (GAS) at review and related data for the 19 children.

Participant ID	GAS 1 Rating	GAS 2 Rating	GAS 3 Rating	GAS 4 Rating	GAS T-score
1	+2	+1	+2		73
2	0	−1	+2		56
3	+2	+2			75
4	−2	+2			50
5	+1	+1	+1		64
6	+1	+2			69
7	+2	+2	−1		64
8	0	0	0		50
9	+2	+2			68
10	−1				40
11	0	−1	−1		41
12	−2	+2			50
13	−2				30
14	−2	−2			25
15	+2	+2	−2		59
16	−2	+2	+2		59
17	−2	−1			31
18	0	+1	0	0	54
19	0				50
Total					1010
Average					53.05

Table II. Goal Attainment Scaling (GAS) at review for the 45 goals: Numbers and percentages.

GAS rating	Number of goals receiving this rating	Percentage of 45 goals
+2 (much more than expected)	16	35.5%
+1 (somewhat more than expected)	6	13.3%
0 (expected)	9	20%
−1 (somewhat less than expected)	6	13.3%
−2 (much less than expected)	8	17.7%

children achieved at or above the expected level after up to six 30-minute teletherapy sessions.

Five of the children achieved below expectations overall, with t-scores below 50. Analysis of the collected data from these five children and of their intervention records, suggested: (i) the treatment for one child's severe stutter may have had reduced efficacy as a family member attended only one session of the offered six, (ii) one child had four sessions, none attended by a family member, (iii) a family member did not attend any of the therapy sessions for one child with three articulation goals that required extensive home practice, (iv) for another child no family members attended, the child appeared unmotivated in the sessions and the grammar goals may not have been sufficiently functional, in view of dialectal differences of Aboriginal English, to have been well supported at home or school and (v) for a fifth child only three sessions occurred, with only one attended by a family member. In terms of technological difficulties, three of the five children were seen at the same school, which used only one set of headphones. This meant that the therapy facilitator could not hear most of the session, possibly limiting the facilitator's ability to give effective assistance.

Individual parent interviews

From the analysis of interview data, four themes emerged: (1) Practicality and convenience, (2) Learning, (3) Difficulties and (4) Communication. The first two themes appeared to be closely related to why parents perceived the programme to be acceptable and the last two themes related to areas parents wanted addressed to improve feasibility.

Theme 1: Practicality and convenience.   Parents contrasted the practicality and convenience of CNS with the difficulties they experienced in accessing regular speech-language pathology intervention. For most parents, no speech-language pathology service was available in their town and there were long waiting times at the closest towns where it was available. The distance to access services also related to high costs in terms of (a) expense (mainly fuel costs, with or without private speech-language pathology service fees), (b) time, (c) inconvenience to the parent, (d) reduced schooling for the child and (e) stress on the child. The inconvenience of accessing non-teletherapy services was described by parents in terms of the difficulty and often costs involved in being away from work and discharging their other responsibilities such as childcare. Parents contrasted these barriers with CNS, which was free and set in the child's school environment. One parent spoke of a private SLP they consulted:

> She wanted us to actually have fortnightly sessions with him. So we would be driving 300 km [there]. We just went "No". There's no way we can go fortnightly, 600 km round trip for therapy, it was just like you've still got the petrol, you've got the day off school, off work for us. You'd have to leave with the sparrows, and arrive back after dark.

Another commented, "We can't afford private speech therapy so we are on a long waiting list. We have been waiting 2 years". Another stated:

> I didn't have to travel, I didn't have to give up a day's work to take him somewhere and then have to worry about where I'm going to make that day's wage up. I didn't have to worry about what I was going to do with the other three kids or do I pull the whole four of them out of school just to take one child to a therapist. It's positive ... he's not distressed because he's had to get car sick travelling somewhere, it hasn't put a big spanner in the works of the family day-to-day routine. Just to drive to Dubbo and back is $80 in fuel. It's a lot of money.

Parents appreciated that, in contrast to local therapy options which were dependent on a family member's attendance, CNS sessions went ahead if a family member could not be present: "It didn't matter if I was here or not he'd still get that". All parents were sufficiently satisfied with the CNS program to state that they wanted it to continue.

Theme 2: Learning.   The parents indicated that the CNS teletherapy sessions had a positive effect on both their child's and their own learning. The parents all indicated that they had noted some improvements in their child's communication, although to varying degrees. For example, one stated, "I can see a big improvement in my child. It has made a big difference. Talking more, understanding a little bit more of what you're saying and also processing, thinking and that". Another judged the improvement to be marginal. Most noted that one therapy block was not sufficient to address all or most of their child's communication therapy needs.

Parents identified the following factors as contributing to their own and their child's learning: frequency of sessions, the visual demonstration of programming and therapy activities and the increased opportunity to question and clarify with the SLP. A parent stated:

> [What worked well was] the frequency of it every fortnight because kids, they forget and if you're not doing it regularly they're going to forget. At least he's got a chance of remembering it more, and the more practice or the more therapy, then the more likely it is that the problem's going to go away.

In the interviews parents were not asked about and did not volunteer a comparison of the effectiveness in outcomes of teletherapy with alternative service delivery models. Three of the five parents indicated that the relative frequency of teletherapy sessions allowed their own confidence in doing home therapy activities to increase more quickly than in their previous experience of less frequent alternatives. One parent indicated that programming and activities were demonstrated more effectively, as this was done not only more frequently, but for longer amounts of time and with a visual element. This was compared favourably to the parents' previous experience of mainly written or telephoned instructions: "We still got a programme, [the SLP] emailed games and various things we could play, but at least if we got that and went 'What do we do with this?' at least the following session we could say 'We don't understand how to follow this'".

Some parents thought the technology helped to motivate their child to take part and to remain engaged in the sessions: "It seemed, like, to me it was the technology part kept him occupied, like, wanting to sit there and listen", and "He'd get there and he'd love it".

One parent indicated that teletherapy appeared to be equivalent to face-to-face with regards to the two-way communication as "It was like her (the SLP) being there anyway because he can see her, she could talk to him".

Theme 3: Difficulties.   Parents noted some difficulties with use of the technology and some inherent limitations in the remote service. Internet

connection was variable, with occasional loss of sound and/or vision at some of the remote sites and some temporary freezing of vision: "I think once or twice the internet was down and they couldn't have their sessions" and "[The town's] internet is not the most reliable. Certain weather conditions you could find that it didn't work".

Some reported a lack of confidence in use of the technology, especially at the start: "To start with I wasn't confident but as I come to most of the sessions I got a lot more confidence in it". Others had no difficulty with the technology: "I was fine with it".

Some parents had difficulty hearing what was said by the SLP. At those sites only one of the two supplied headsets was in use (as only one computer was available for use at the remote site). Parents at these sites had to lean in close to their child and sometimes strained to hear while the headset was worn by the child during the bulk of the session. Some sharing of the headset was necessary and the adult could not speak to the SLP while the child was using the one headset: "If I sit close enough to my child I can hear through the headphone" and "I couldn't hear what she was saying to him".

One parent indicated that the child might have developed more rapport with the clinician in a face-to-face approach: "I think when you're speaking to somebody face-to-face there's more … For a child they can connect a bit more I think". Another parent noted that a disadvantage of teletherapy was that the SLP could not observe the child's functioning outside the clinic room: "Because it's delivered on the computer the therapist wasn't actually here in the playground to see him try to implement some of the stuff that she'd given him".

Theme 4: Communication. The parents suggested several areas for improvement. The major area was communication between the various stakeholders in the program. "What I was originally told [about when] the sessions were happening, they weren't happening, they changed them from a Monday to a Thursday. I didn't realise that … until I was requested to be at the last session". One parent spoke of insufficient communication between the SLP and the parent: "Maybe [the SLP could] pop me an email because the communication doesn't always get passed through". Another parent stated that there was insufficient time to speak to the SLP in depth about home therapy activities. One parent was concerned about reduced privacy when doors were left open or when a therapy aide was present. Another parent wanted increased clinical visits from the SLP to supplement the remote service.

Discussion

Our study's quantitative results demonstrated that participation in a speech-language pathology teletherapy program using low-bandwidth videoconferencing can improve the speech and language skills of children in both early childhood settings and primary school. The majority of the treatment goals for the broad-based program were achieved to a level expected by the treating SLPs. Where some of the children did not meet expectations overall, analysis supports the view that SLP teletherapy services may be more effective if, prior to enrolling children in an intervention phase, there is thorough engagement with parents/caregivers and schools in the negotiation of meaningful intervention goals, family member attendance at sessions, and the nature of the home or school practice activities likely to be required for progress. Elimination of barriers to effective Therapy Facilitator assistance between teletherapy sessions is also likely an important factor in reducing the incidence of lower than expected progress.

Our qualitative results indicated that parents viewed this teletherapy program as feasible. Parents who had experience of alternative methods of speech-language pathology delivery reported that the teletherapy services were more practical, convenient and efficient in teaching therapy techniques and activities than what they had experienced to date. These other service delivery models were reported to be less frequent, with less verbal parent instruction and feedback. The study findings also highlighted the areas of internet connectivity, audio output and communication between stakeholders as aspects to strengthen, troubleshoot or monitor.

These findings are important as they support the view that teletherapy solutions delivered by relatively low-cost technology can eliminate for some children and their families significant barriers to accessing speech-language pathology services. The results demonstrate in the Australian context one solution to a chronic situation of grossly inequitable access to services in rural and remote regions (Dew et al., 2013).

As in the study of Lincoln et al. (2014), this study utilises a flexible method of evaluating program efficacy through the use of GAS. GAS differs from approaches that solely use the results of formal standardised assessments as clinical measures and approaches that use the broad universally applied functional rating scales of Grogan-Johnson et al. (2010, 2011). Although similar to the therapy goal progress rating scales as described by Grogan-Johnson et al. (2010), GAS is arguably less subjective. GAS allows overall or cohort program evaluation after client re-assessment and after short amounts of therapy (such as six sessions in this study) and allows the evaluation of progress for discreet individualised therapy goals that have been negotiated with stakeholders to reflect both functional utility and stakeholder priorities. This study suggests that GAS would have

advantages as an evaluation tool for health services provision within a family-centred approach and in the short time-scales of school term-by-term planning.

The study has demonstrated the utility of thematic analysis of interviews in identifying factors that contributed to the parents' perceptions of the feasibility and acceptability of teletherapy. This analysis allows a deeper and richer understanding of parent perceptions than most previous studies using satisfaction rating scales alone and appears to be a valuable tool for the design and evaluation of teletherapy services.

The current results are consistent with those of school-based speech-language pathology services previously reported in the literature (Grogan-Johnson et al., 2010, 2011). The results of this study support and build on the findings of Lincoln et al. (2014). For example, almost three times as many goals (45 goals as opposed to 16 in Lincoln et al.) were examined; the sample size of children was doubled (19 in the current study, nine in Lincoln et al.); the age range of child participants was expanded (3–12 years compared to 7–12 years) and the inclusion of early child care settings (21% of the clients in our study). Moreover, the maximum number of therapy sessions provided was six, compared to 12 in the Lincoln et al. study. Four speech-language pathologists provided therapy to the children, compared to only one providing services in the Lincoln et al. study, a feature which enhances the generalisability of our findings. Taken together, these similarities and differences between the two studies suggest that the results are robust in a large service provided by multiple clinicians across multiple settings.

Our qualitative findings agreed with the findings of Lincoln et al. (2014) that parents found CNS an acceptable model of service delivery that improved access to a service through reduced travel time and cost and increased convenience. While the themes derived from the parents in the study of Lincoln et al. cannot be separated from those of the other two groups of stakeholders whose views were reported, our study's reporting of themes from parents only informs future teletherapy service design that seeks to increase parent's engagement in teletherapy.

Past researchers have made broad statements about stakeholder satisfaction with teletherapy services. Our results document the reasons for high levels of parental satisfaction, such as reduced travel and cost. Our qualitative findings are similar to those of Crutchley and Campbell (2010), whose report of levels of satisfaction for various aspects of their teletherapy program for several groups of stakeholders is a potential model for future research on satisfaction with teletherapy services.

Limitations of the study

Although the sample size in this study is larger than some previous studies, it is still relatively small. Another limitation is that we did not capture the views of other important stakeholder groups such as principals, teachers, therapy facilitators and participating SLPs.

Suggestions for further research

This study is an impetus for further research into the efficacy of teletherapy treatments to overcome access barriers. This study leaves unanswered the question as to whether outcomes for children are equivalent from teletherapy and face-to-face delivery of speech-language pathology services. Previous research has tended to mix the results of samples from face-to-face one-to-one therapy with group therapy. Future research should compare one-to-one teletherapy with one-to-one face-to-face therapy and compare group teletherapy with group face-to-face. Given the promising results of this study, randomised controlled trials are justified to compare the progress rates and outcomes for teletherapy and face-to-face therapy where samples are matched for diagnosis, therapy goals and length of treatment. Future research needs to address some of the following research questions: How can teletherapy most efficiently deliver outcomes equivalent to, or indeed superior to, face-to-face interventions? When is speech-language pathology teletherapy inappropriate? What modifications to standard face-to-face interventions are needed in teletherapy practice to ensure maximum child engagement and acceptability to stakeholders?

Conclusion

This study strengthens the evidence base for school-based, speech-language pathology teletherapy services in rural and remote schools and childcare settings. The majority of the treatment goals for the broad-based program were achieved at or above levels expected by the treating SLPs. Parents identified that the teletherapy service was both feasible and acceptable. Parents welcomed the teletherapy service, particularly because it allowed more frequent and consistent services which in turn promoted their confidence and skill in assisting their children to achieve their speech and language goals. Communication between SLPs, parents/carers and teachers emerged as an important issue for success. The results suggest that it may be possible to reduce inequity of access to SLP services in rural and remote communities through teletherapy.

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