Speech and Language Services Using Telehealth Technology In Remote and Underserviced Areas

Les services orthophoniques utilisant la technologie de télésanté en régions éloignées et sous-desservies

ShawnaLee Margaret Jessiman

Abstract

The use of telehealth technology was used to determine if it was a potentially effective and efficient method of providing speech and language services in remote and historically underserviced areas in northern Alberta. Speech and language assessments were completed on two school-aged children using both telehealth technology and in-person assessments to compare the sound quality and overall efficacy of the telehealth system. Several technological and logistical problems requiring modification were encountered both during the assessment and treatment services. Based on these problems and modifications, suggestions are made with regard to appropriate equipment, room set-up, personnel, client selection, and service delivery. Even given the difficulties experienced, the effectiveness of the telehealth technology appears promising.

Abrégé

La technologie de télésanté a été utilisée afin de déterminer si celle-ci peut constituer une méthode efficace et efficiente d'offrir des services orthophoniques en régions éloignées et généralement sous-desservies du nord de l'Alberta. Des évaluations orthophoniques ont été effectuées auprès de deux enfants d'âge scolaire en employant à la fois la technologie de télésanté et l'évaluation en personne afin de comparer la qualité audio et l'efficacité générale du système de télésanté. Plusieurs difficultés technologiques et logistiques nécessitant des correctifs ont été relevées pendant l'évaluation et le traitement. Compte tenu de ces problèmes et modifications, des suggestions ont été faites à l'égard de l'équipement approprié, de la disposition de la pièce, du personnel, de la sélection du client et de la prestation des services. En dépit des difficultés notées, l'efficacité de la technologie de télésanté semble prometteuse.

Key words: telehealth, speech-language pathology, assessment, treatment, rehabilitation, service delivery

Access to health care services for individuals living in remote rural areas is an ongoing issue. Due to time constraints, budgetary issues, and understaffing in rural health regions, waiting lists for speech and language services are often very lengthy. Access to speech and language services in remote areas comes with a high cost to either the health authority or the health care recipient when one factors in the service provider's travel time, client's travel time, and travel costs.

Providing speech and language services using telehealth is an exciting and promising approach for possibly reducing costs, as well as reducing inconveniences to clients and service providers. Telehealth is not a new approach, but it is certainly an uncommon approach for speech and language service delivery. Duffy, Werven, and Aronson (1997) discussed how speech-language pathology was among the first clinical services

ShawnaLee Margaret Jessiman
Keeweetinok Lakes Regional Health Authority
Slave Lake, Alberta

provided through telehealth through the Mayo Clinic facilities in the late 1980s. They also reported good results based on their eight assessments with adult clients. Preliminary research by Wertz, Dronkers, and Bernstein-Ellis (1992) using advanced telecommunications was also encouraging for assessing individuals with neurogenic communication disorders. Kully (2000) also reported positive preliminary outcomes regarding the telehealth medium for providing adult stuttering therapy follow-up services. Outcomes of all three of these preliminary studies indicate that speech-language pathology services offered in this manner can be successful with adults. Little information is available, however, with regard to assessing and treating children with speech and language disorders using telehealth technology.

This field report provides preliminary information on the use of telehealth technology in the provision of speech and language assessment and treatment services for two school-aged children. Articulation assessments were completed using the telehealth equipment and in person to ensure that the equipment was sensitive enough to provide accurate feedback of speech sounds and language forms. Treatment sessions were provided twice a week for two months targeting selected articulation and language goals. Progress was noted via clinical observations, informal probes, and parent feedback. Client satisfaction was documented via telehealth satisfaction surveys obtained posttreatment. Although there were technological and logistical problems in providing these speech and language services, modifications were made and suggestions given for further speech and language sessions using telehealth. The effectiveness of the telehealth technology was evident when the appropriate equipment, room set up, personnel, clients, and service delivery were in place.

Existing Telehealth Equipment and Personnel

This project was completed in May 2000. The services in this project were provided using an existing Regional Satellite Based Telehealth System. The telehealth equipment where the speech-language pathologist (SLP) was located included a document camera (to show stimulus items such as pictures and objects to the client), a room camera (focussed on the SLP), and a television monitor (that displays the clients' image to the SLP). At the clients' site there was a room camera (that recorded the client) and a television monitor (that displayed the image of the SLP). The SLP controlled the cameras at her site, but could not control the room camera at the clients' site.

The sessions were conducted in rooms that were not specifically designed for telehealth use in that they were neither acoustically nor colour treated. In this case, the telehealth room was in one of the nurse practitioner's clinic rooms, and had only a large table and chairs that were not ideal for children.

The sessions were conducted with the help of a minimally trained telehealth facilitator at the remote site in combination with the parents. The facilitator was the northern community health care site's receptionist who had been shown how to use the equipment and how to make minor adjustments to volume and camera placement. The facilitator then instructed the family on the use of the equipment and how to make volume and camera adjustments.

Service Delivery Before Telehealth Technology

Prior to the use of telehealth technology, the nurse practitioners in the remote northern Alberta communities referred clients to the SLP. The parents were then expected to travel to the closest full-service health care site for an initial assessment (approximately 350 km round trip). The SLP assessed the client and then discussed the results with the parents. Treatment options were limited and typically involved the development of an individualized speech and language program to be implemented by the parents or school personnel.

After the programs were developed, the SLP spent a day travelling to and from the community to explain the programs to parents and teachers. In this case, the programs were provided to the school to implement as the parents both had significant hearing losses with resulting speech and language difficulties. Follow-up was to take place at the school's request; however, typically it was not requested due to lack of school personnel who were able and willing to carry out the programs.

Speech and Language Assessments With Telehealth

Articulation Assessment Using Room Microphones and Telehealth

Once the telehealth system was in place, services to the two school-aged clients living in that same remote community looked much different. Neither the client nor the SLP had to travel any great distance and the clients were seen much more quickly as scheduling was easier. The clients' articulation skills were assessed using the Structured Photographic Articulation Test featuring Dudsberry (Kresheck & Tattersall, 1993) over the

Table 1
Sound Errors Noted in Articulation Assessments for Child B

Sound	Initial Position			Medial Position			Final Position		
	T-H room mic	In person	T-H lapel mic	T-H room mic	In person	T-H lapel mic	T-H room mic	In person	T-H lapel mic
f	deleted	correct	correct				deleted	correct	correct
v	b	b	b						
θ	s	lateral	s	t	t	deleted	s	t	s
ð	d	d	d	d	correct	correct			
s	t	lateral	lateral	d	d	d	t	t	t
z	deleted	dʒ	d	t	lateral	lateral	t	t	t
ʃ	lateral	tʃ	tʃ	s	tʃ	tʃ	tʃ	lateral	lateral
tʃ	ʃ	lateral	lateral				ts	correct	correct
dʒ	d	correct	correct	d	correct	correct	ts	tʃ	tʃ
l	deleted	correct	correct	w	w	w	w	w	w
r	w	w	w	w	w	w	w	w	w
s blends	s deleted	s deleted	s deleted						
l blends	glided	glided	glided						
r blends	glided	glided	glided						

Note. The assessments were completed under three conditions. T-H room mic = Telehealth equipment using room microphones, in person, and T-H lapel mic = Telehealth equipment using lapel microphones.

telehealth system using existing equipment, which included room microphones only. Child A, aged seven years, experienced difficulties producing final /θ/, beginning /ʃ/, medial /l/, and /s/ blend sounds. Based on Sanders (1972), a child at this age is expected to be correctly producing all speech sounds except possibly /s/, /z/, /ð/, /ʒ/ and /v/. Child A presented with a mild articulation delay. Child B, aged five years four months, experienced difficulties producing fricatives (/f/, /v/, /θ/, /ð/, /s/, /z/, /ʃ/), affricates (/tʃ/, /dʒ/), liquids (/l/, /r/), as well as consonant blends (/s/, /r/, and /l/ blend sounds). Child B presented with the following phonological processes: stopping, gliding, and cluster reduction which, according to Grunwell (1982), should no longer be present.

Articulation Assessment In Person

The articulation assessment was then repeated three days later in person. This reassessment was undertaken to determine if what was heard using the telehealth equipment was accurate with regard to the children's articulation and phonological skills. This comparison was necessary to determine if the sound quality and sensitivity of the telehealth system was adequate to complete accurate speech and language assessments and treatment. It was apparent that certain sound classes (fricatives, affricates, and /s/ blends) were problematic with regard to being heard accurately using the current telehealth technology and equipment. The correctness versus incorrectness of the sound could be judged over the telehealth system; however, it was difficult to ascertain what sound or distorted sound the child was actually making in place of the target sound. This distinction is very important and has implications for treatment methods and judging treatment progress.

The in-person assessment revealed that Child A encountered difficulties only with producing ending /θ/ and /str/ blends: not /ʃ/ and medial /l/, as originally heard through the telehealth equipment. Given this new information, Child A's articulation skills were age appropriate. For Child B, the biggest difference between the testing situations was that initial and final /f/, medial

/ð/, final /tʃ/, initial and medial /dʒ/, and initial /l/ were all produced correctly when assessed in person, but using the room microphone and the telehealth system these sounds were heard as incorrectly produced. The other significant difference was that the production of initial /s/, medial /z/, and initial /tʃ/ were laterally produced, but this was missed using only the room microphone and the telehealth equipment. A sound-by-sound error comparison in the different testing situations for Child B is shown in Table 1. It was apparent that better quality microphones were necessary to allow for a more sophisticated audio signal.

Articulation Assessment Using Lapel Microphones and Telehealth Equipment

To help with the audio difficulties, lapel microphones were purchased and sent to the remote site where the speech and language treatment would take place. This resulted in a three-month delay in the start of intervention. To ensure that the changes heard in the clients' speech production using the new microphones were in fact due to the improved sound quality and not actual improvements in the clients' articulation skills, the children's speech sound production skills were reassessed once more while they wore lapel microphones. The results of the articulation assessments conducted in person and using the lapel microphones were almost identical. The children were still experiencing difficulties correctly producing all of the previously noted speech sounds. The sound quality and clarity of affricates and fricatives using the lapel microphones were much improved compared to using standard microphones. The only sound that was not accurately heard over the telehealth system using lapel microphones for both children was /è/.

Language Assessment

The clients' language skills were also assessed using the Test of Language Development - Primary Third Edition (Newcomer & Hammill, 1997) and/or Clinical Evaluation of Language Fundamentals – Preschool (Semel, Wiig, & Secord, 1992). Child A presented with a mild receptive and expressive language delay. He experienced difficulties with understanding concepts (few, neither, nor) and using correct word forms (future tense, irregular past tense, possessive forms, plural forms, and irregular plurals). Child B also presented with a mild receptive and expressive language delay. He experienced difficulties with using the correct word structures (pronouns, possessive forms, third person singular verbs, irregular past tense verbs, future tense verbs, and passive voice). Language assessments were done only in person and not using the telehealth equipment due to test-retest time constraints; however, informal language probes were completed before treatment began to ensure that the children were still experiencing difficulties with the chosen language goals.

Speech and Language Treatment Using Telehealth

Goals for Treatment and Session Set-Up

Treatment goals were aimed at improving the clients' articulation skills (/ʃ/ and /str/ blend sounds), as well as understanding and use of language forms (such as possessive nouns, plural nouns, future tense verbs, pronouns, and linguistic concepts). Treatment sessions took place twice weekly for a period of two months. The family and school staff were encouraged to practise between sessions. The treatment sessions initially needed to be longer (one hour per child) to allow for adjustments to be made to the telehealth equipment and to accommodate the client's and SLP's comfort level using the equipment. After the first four sessions, everyone involved (the clinician, family members, and the facilitator) became more familiar with the equipment and less time was required. The session times were then decreased to one half hour per child.

At the beginning of treatment, the majority of the interaction was between the child at one site and the SLP at the other site. Materials were faxed or mailed to the remote site for parents to use with their children. The SLP instructed the child on the tasks, judged the accuracy of the child's response, and provided feedback. As the child progressed and the parents' understanding of treatment improved, the role of the SLP shifted. The SLP described what to do and the parents carried out the therapy activities during the telehealth sessions. The SLP monitored the client's productions for accuracy (as the parents were unable to do this due to their own hearing losses) and decided when to move forward in the goal hierarchy.

Speech and Language Gains

Both Child A and B progressed in their speech and language goals quickly over the 12 sessions. This may be attributed, at least in part, to the therapy sessions given that over the three months between assessments and prior to beginning services, no improvements were noted. Child A made substantial progress during the 12 sessions based on the informal probes completed after treatment and by parental report. This child mastered the use of /str/ blends in speech, possessive and regular plural forms, and concepts (few and neither/nor) and included them into his conversational speech. He also used irregular past tense verbs, irregular plurals, and future

tense verbs in structured environments. Child B's progress was less substantial, but still appeared promising. Based on informal probes completed after therapy and through parent report, this child mastered the use of initial /ʃ/ sounds in conversational speech and was able to correctly use possessive nouns, future tense verbs, and subjective and objective pronouns in structured situations. Parent questionnaires were completed before the start of telehealth therapy, at the mid-point of the treatment, and after treatment ended. On the posttreatment questionnaire, the parents reported satisfaction with the gains their children made and with services using the telehealth technology.

Technological and Additional Problems

Several difficulties were experienced during the delivery of telehealth services. This included equipment problems, signal time delays, and issues related to room set-up. However, these technical and logistical problems were rectified quickly allowing for the sessions to run smoothly.

Equipment-Related Problems

The children frequently knocked the lapel microphones off the clips and fidgeted with the microphone wires which negatively influenced sound quality. Microphones were then clipped on the front of the child's shirt with the cord running under the shirt and over the shoulder to the back where it was clipped on the back of their pants. This adjustment solved the problems associated with microphones. Use of vests or head microphones may also have been beneficial, but were unavailable at the time.

Time Delay Concerns

After microphone-related problems were resolved, the difficulties related to the audio time delay remained and proved troubling to the child, parents, and the SLP. Using the existing telehealth equipment, the video signal reached the distant site and then there was a two to four second delay before the audio signal was heard. This resulted in unsynchronised video and audio signals. For example, a child could be shown a picture stimulus and respond before the SLP heard the child's response. In this situation where real-time mismatches existed, the child already would have moved on to the next item before they could hear the SLP's comments or feedback. This problem was resolved by reminding children to pause before they continued speaking. The parents reminded the children that the SLP had not yet heard them, and this delay became less problematic once everyone was accustomed to it. This large time delay is not anticipated with newer telehealth equipment.

Room Set-Up

The rooms where the telehealth equipment was set up were neither acoustically nor colour treated. It is best if the equipment is set up in its own specially designed room. This would include soundproofing and consideration of room colour. If the telehealth setting is not sound proofed, the use of heavy curtains is recommended to absorb sound. In order to provide the best visual contrast with regard to video signals, a medium blue colour is recommended for the room. The use of heavy blue curtains also may provide sound absorption and visual contrast. In many remote sites, the room in which the telehealth equipment is set up is neither solely dedicated to this equipment nor set up properly. Even installing curtains can prove difficult due to budgetary constraints. This caused some problems with background noise from telehealth equipment and/or from other areas of the building. This did cause some interference throughout the speech and language treatment sessions.

Volume control was also problematic at the beginning. Initially the volume had been set too low and when increased, it began to echo. Two sessions into the treatment a head-mounted microphone was purchased for SLP use. After this, the child's' family and facilitator in the remote community reported improved audio quality.

In situations where the table height was not ideal, this was overcome by simply having the children either sit on the table or by moving the camera so as to focus better on the children. It was also noted that the younger child moved around more, so the ability to move the camera in order to keep the child in view is important.

One issue that was considered was the difficulty in establishing a rapport with children using telehealth methods. As the children discussed herein were not unknown, rapport building was not a real problem. With only one video camera and one monitor, the child may miss nonverbal reinforcement (such as smiles, head nods, and hand gestures) when the SLP shows them stimuli with the document camera. It would be beneficial to have two monitors so that both the stimulus camera and the child camera can work at the same time, or to have split screen technology (where both video signals can be seen simultaneously).

It was very apparent that the quality of the equipment, personnel, room set up, and children all had a large role in the viability of the speech and language assessments and treatment using the telehealth equipment. Once the technological problems were addressed, sessions ran smoothly.

Summary and Recommendations on Telehealth Sessions

Given these preliminary experiences, some modifications should be considered. In order for the telehealth technology to be effective and efficient in assisting in the provision of speech and language services in remote settings, it is important to ensure that: (a) equipment and peripherals are of good quality, (b) the set-up of the room is optimal, (c) there are trained facilitators available at both sites, (d) potential clients have been carefully selected, and (e) the type of service delivery is appropriate.

With regard to equipment, the use of head-mounted microphones is strongly recommended as it will reduce the amount of external noise. If the client will not wear a head-mounted microphone, the use of lapel microphones and vests is recommended. Hiding wires is also highly recommended (putting them under the client's vest or shirt is an option) to decrease the chance that children will play with the wires. The use of a headset for the SLP is also recommended to improve the sound quality sent to the client's site and to reduce feedback.

A high-quality adjustable camera for client and SLP is suggested to ensure good visual images. This will allow the SLP the ability to *easily* adjust the camera at the client's site, ensuring that the SLP can see the client at all times. The ability to use two cameras and two monitors at the same time (or a split screen) is strongly suggested so that the clients can see both the clinician and the stimulus materials. This split screen also may allow for improved rapport and visual reinforcement from the SLP during sessions. The ability for the telehealth equipment to send and receive signals quickly in order to minimise or eliminate audio and video delay is essential. With newer equipment, this delay is not as noticeable.

If possible, the room needs to be acoustically and visually treated (e.g., blue walls, heavy blue curtains, etc). The room should be large enough to comfortably hold all equipment, a client appropriate table, several chairs, and others involved. The room should be dedicated to telehealth use if at all possible to decrease disruptions to equipment and set-up, and it should be located in a quiet area to reduce ambient noise and improve signal quality. The camera should be placed on top of the viewing monitor to ensure that you are looking directly at the camera while at the same time being able to observe the client on the other end. If the camera is pointing at the clinician from a different location/ direction, the client on the receiving end will not have the benefit of seeing your face straight on.

An on-site facilitator is suggested. The facilitator should be trained and knowledgeable in use of equipment and trouble-shooting, as well as speech and language techniques. In their study of telehealth effectiveness, Liu and Miyazaki (2000) suggested the importance of having trained and dedicated staff for technological support. Access to a family member or aide/assistant to work with the client is also essential.

Clients who have highly motivated families are excellent candidates for speech and language services using telehealth technology. Clients who have access to an aide or assistant are also good candidates for this method of service delivery. Clients should have the ability to focus and attend to the task, as well as being able to sit for speech and language sessions. A wide range of client needs could be serviced using telehealth. Clients with articulation problems and phonological delays, language delays, voice or fluency disorders, and others would appear to be appropriate if telehealth requirements are met.

Shorter sessions (20 to 40 minutes) appear to be appropriate for younger children. Sessions with older clients can be longer (30 and 60 minutes) depending on their needs. In the beginning, direct treatment with the SLP may be appropriate, whereas parents or assistants can take a more active role later on in the treatment program. Clients also will need access to speech and language materials on-site.

Based on these two preliminary experiences using telehealth applications, an alternate approach for providing speech and language services to remote underserviced areas has been demonstrated. Continued investigation into cost effectiveness and reliability of telehealth is suggested. The present experience suggests that speech and language assessment and treatment could in fact be conducted using telehealth equipment if the previously discussed requirements are considered and addressed accordingly.

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