Access to Pediatric Voice Therapy: A Telehealth Solution

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Structured Abstract

Purpose: The purpose of this study was to determine the feasibility of using secure teleconferencing and Web-based systems to deliver pediatric voice therapy.

Scope: Children with voice disorders are at a social and educational disadvantage and access to adequate services for treatment can be difficult. The incidence of pediatric voice disorders are reported to occur in 6-23 % of the pediatric population. In this study synchronous and asynchronous systems were developed and used to deliver voice therapy to 10 children diagnosed with a voice disorder. All therapy sessions were conducted via secure Internet connections and a secure interactive Web portal designed and built for this study.

Methods: This study had two components: The design, construction, testing, and launching of the interactive Web portal; and eight weeks of voice treatment. Equipment was dispensed, children and families trained, and therapy was provided from hospital to home. The use of these systems by pediatric participants, families and pediatric voice care specialists was evaluated.

Results: Ratings of satisfaction and similar measures provided by both participants and clinicians strongly support the feasibility of using telehealth to deliver voice therapy to children. Technology stability fluctuated due to variable participant Internet provider upload speeds but most of these issues were overcome. Constraints were discovered regarding the acoustic fidelity of Internet transmission of the human voice. Importantly, parents reported that the use of telehealth relieved numerous family burdens encountered when accessing needed services for their child.

Key Words: Telehealth; pediatric voice care; voice therapy; self-management; clinical monitoring

Purpose

Under optimal circumstances voice treatment is delivered by experienced voice specialists but unfortunately there is limited access to quality pediatric voice care. The reasons for this widespread problem include a clinical work- force that is generally unprepared to treat this population, overloaded public school clinician caseloads and family burden issues. These issues are exacerbated in rural or similarly underserved areas of the country. Given the need for access to highly specialized clinical skills, the suitability of individual voice therapy to this model of care in adults, extending the telehealth (TH) concept to treatment of pediatric voice disorders was a novel, albeit logical step. ***The central purpose of this study was to determine the feasibility of using a telehealth solution for delivering pediatric voice therapy via secure teleconferencing and Web-based systems.*** We evaluated its use by patients, families and pediatric voice care specialists. The motivating hypothesis was that an informed, feasible and personalized approach to pediatric voice care via telehealth was possible and would result in improved patient access to quality care, thus leading to greater self-management and clinical monitoring. This investigation collected data for a larger R01 proposal. We also expected that we would provide evidence that a telehealth approach would relieve a family's burden related to access, travel and the complex nature of family schedules and scheduling therapy. We accomplished the objectives of this application by executing the following specific aims:

Specific Aim 1 (SA1): Tested a pilot program of personalized voice therapy in ten children using a telehealth approach. Assessing the quality and stability of synchronous and Web-based audio/video data transmission and measuring progress in therapy was the principal components of this aim. We hypothesized that voice intervention can be successfully delivered (for a course of 8 treatments per participant) via videoconferencing (VC) and concurrent Web-portal "e-practice" by experienced voice clinicians with minimal technology-related challenges. Success was evaluated by 1.technology stability ratings and 2.change in participant voice quality. The latter will be measured via acoustic, perceptual; handicapping scores and sustained phonation times during exercises.

Specific Aim 2 (SA2): Explored the personal and interpersonal benefits and obstacles surrounding delivery of pediatric voice therapy using telehealth. We anticipated that on average a) The clinician-patient relationship will be rated as being good to excellent; b) Compliance issues as measured by therapy attendance and adherence to instructions would be better than or equal to those reported for face to face therapy; c) Participating in telehealth sessions would result in a measurable easing of family burden and personal cost savings; and that we could d)

Identify what, if any, adaptations to traditional voice therapy techniques must be made for successful telehealth service delivery.

This proposal responded to the documented criteria listed for PAR-08-269. It aimed to support patient centered care and the delivery of care across care settings (e.g. hospital to home). This project was responsive to the strongly expressed needs and preferences of many of our patients and families. Our outcomes will add evidence and direction to the role of telehealth in delivering speech language services to the pediatric population. Having people access and engage in therapy from their home environment will empower individuals to take a more active role in their treatment and care.

Scope

Background

Childhood dysphonia is associated with social withdrawal and depression that can negatively influence social, emotional, educational and occupational outcomes.[1,2] Parents complain their children are not understood or are perceived as ill by teachers and peers. Voice disorders occur most often when there is some type of laryngeal use injury or disease that results in swelling, tissue damage or the development of benign vocal fold lesions (e.g. nodules). These conditions may be congenital or acquired. The degree to which voice production is affected often reflects the severity of the injury to the vocal folds themselves. A voice disorder is defined by parameters like breathiness, roughness, pitch instability (too high or too low), volume instability and effort required to vocalize. During childhood, the reported incidence of voice disorders ranges from 6%-23%.[3,4,5]

Secure Internet transmission of voice (speech) and visual data has emerged as an effective means by which to increase patient access to specialized allied health services 6, [7,8,9] but prior to this study treatment of childhood voice disorders was not yet among them. There was also evidence building in the psychology literature that working with children and parents via the Internet and Web-based behavioral therapy modalities is efficacious and desirable, but only a few studies have reported on the use of telehealth to treat communication disorders of childhood.[8,9] It has been successfully used to improve access and compensate for clinician shortages in the areas of speech sound disorders and fluency (stuttering) but voice disorders are notoriously undertreated and not yet tested using this method of service delivery. Considering the consumer use of rapidly advancing and sophisticated personal technology, alternative ways

to access a variety of healthcare services including a sub-specialty area like pediatric voice therapy was warranted.

The current study took place across two settings, hospital and home. The Center for Pediatric Voice Disorders (CPVD) is located within Children's Hospital Medical Center and is a national and international referral center for children with voice and airway disorders. Eligible participants were ten children between the ages of 8 and 15 years who were evaluated in the Center for Pediatric Voice Disorders, CCHMC and diagnosed with a voice disorder. The 10 children, 5 females and 5 males (median age: 11.1; range 9-14 years) were referred for voice therapy by their OTL. Nine of the children lived in Ohio and one lived in northern Kentucky. Nine of the families resided in suburban settings and one family resided in a rural area of central Ohio. The underlying etiologies contributing to the presence of a voice disorder included bilateral lesions (n=7), UVFP (n=1), dysphonia/puberphonia (n=1); and airway reconstruction (n=1).

Methods

The voice therapy activities described were selected from a range of established techniques that will be personalized for each individual child's needs. As noted, per standard care, each participant underwent an in-facility voice evaluation for physician diagnosis, determination of inclusion eligibility, therapy direction and baseline data collection.

Research Design and Methods:

The synchronous therapy sessions and Web-portal access required the installation of in-home technology and user training. After the initial evaluation and informed consent was obtained, the technology was set up in the participant's home and user training from IS and the study coordinator (SC) took place. Eight (30 minute) individually designed voice therapy sessions were scheduled to take place in as many weeks, as possible. It was intended that independent participant practice sessions using the Web-portal would take place once per day x 5 days per week for 8 weeks.

Equipment: The equipment described below is for the needed computer technology and web-portal access.

Computer technology for Synchronous and Web-portal Sessions

Hardware: Hardware requirements for video interaction required high-end graphics with appropriate processing power. Equipment for in-home and therapist configurations are specified in Table 1. A schematic is depicted in Figure 1.

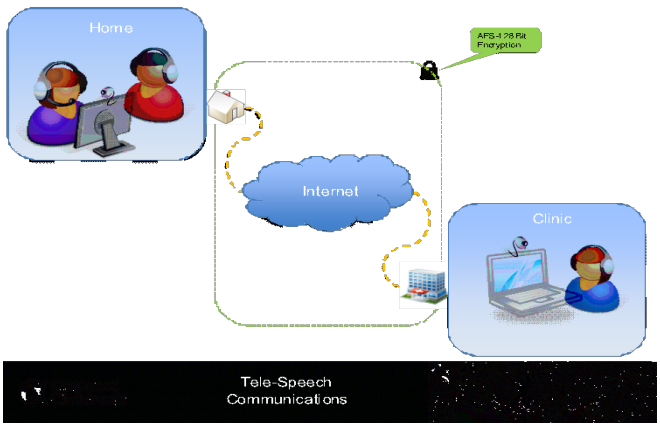
Table 1. Hardware equipment specifications for synchronous therapy component.

Patient In-Home Configuration	Therapist Configuration
➢ HP Business Desktop 8200 Elite - Intel Core i5 CPU @ 2.7 GHZ - 4 GB RAM - 250 GB Hard Drive - DVD Drive - ATI Radeon 5450 512 MB Graphics Card ➢ HP 19" LCD LA 1951G w/ Speaker (for audio playback of videos etc.) Or HP ProBook Laptop. ➢ Microsoft LifeCam Studio HD Webcam Sennheiser PC 230 Headphone/Mic with increased acoustics and high definition with low interference	➢ HP EliteBook 8460p - Intel Core i5 CPU @ 2.5G Hz - 4 GB RAM - 320 GB Hard Drive - DVD Drive - Integrated HD Webcam - Integrated Microphone ➢ Audio-Technica Noise-canceling headphones

Software: Software requirements for video interaction require basic PC operating system needs. In addition, compatibility specifications were cross-referenced on all components to include the patient web-portal, video client, and standard anti-virus requirements.

- Windows 7 Enterprise 32-bit
- Internet Explorer 9 with appropriate plug-ins (Flash, Java, etc.)
- Microsoft anti-virus software
- Cisco Telepresence: Jabber
  - Connectivity: To provide ample in-home Internet connectivity, it was hoped participants had the following minimum high-speed broadband requirements. High-speed Cable or DSL
    - Download – 1.5Mbps or greater
    - Upload – 1.5Mbps or greater
  - These requirements were eventually lowered due to participant constraints (see results).

Figure 1. Schematic of synchronous (point to point) configuration.



Software based security is composed of restricting access on the PC to only approved applications. Anti-virus software is installed and updated every four hours provided the PC is powered on and connected to the Internet. Telemedicine communication requires secure HTTPS authentication to the Cincinnati Children's Telemedicine

Network. Once authenticated, all video calls are encrypted via TLS-256 bit encryption.

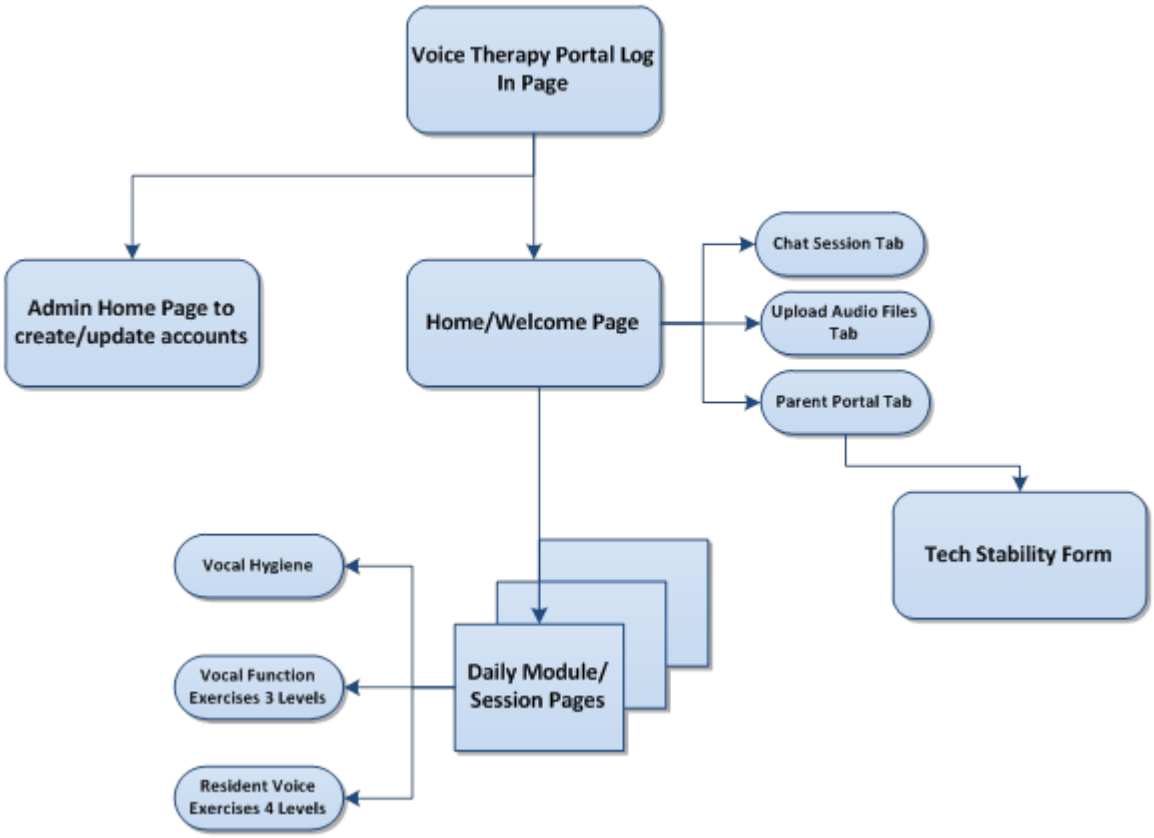
Phase 1: Web-portal Construction

The Web portal was designed to provide individually secure "sessions" consisting of a mix of informational and interactive content including up to 10 data forms - each with 10-20 data points, which parents/caregivers were asked to complete at various intervals. Components of the Webportal are listed below (see Figure 2.)

Components:

- File management module for clinician and patients to upload audio/video files and complete questionnaires;
- Message board/chat module to securely communicate with facilitators and access home practice assignments;
- Data export for purposes of analysis;
- Public-facing home page with user management interface (accounts/settings/permissions);
- Pre-loaded therapeutic practice sessions with audio and video demonstrations that permitted advancing through multiple levels of difficulty

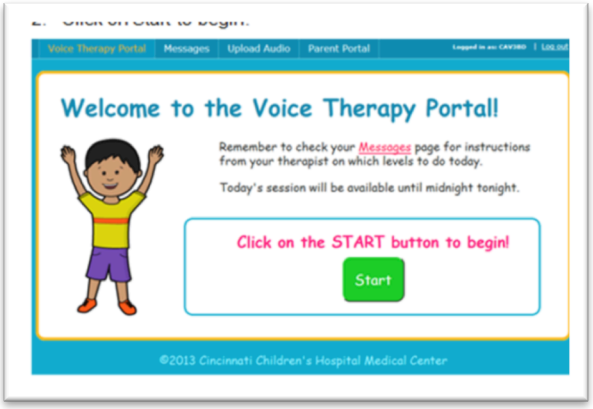
Figure 2. www.myvoicecare.org system design.

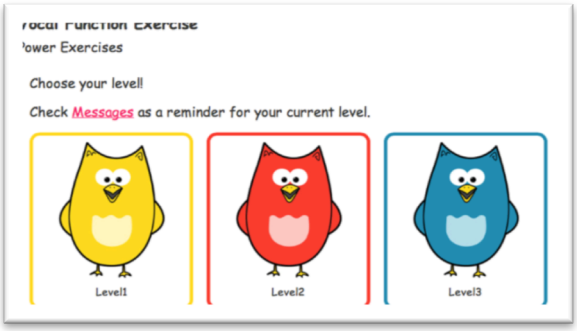


Via the portal, we tracked progress in therapy, compliance, technology stability, satisfaction and cost related data for the participant and the clinician. The daily practice sessions were designed to last approximately 10-15 minutes and timed out (if no activity) after 20 minutes. Access rolled over after 24 hours permitting study observation of adherence to daily practice recommendations.

The Webportal used graphics that were designed for this unique use and were appealing to children. Its URL/Domain name is www.myvoicecare.org (see Figures 3, 4).

Figure 3 & Figure 4. Sample pages from www.myvoicecare.org





Total storage requirements of the site were designed to be 2-5GB based on plans for 15 acoustic wav files (each 8-10 MB), 10 video clips (each up to 100 MB) and, for each participant, up to 20 audio samples (no larger than 3MB). Each participant was provided a secure, password protected individual location on the site. The CCHMC department of Bioinformatics was contracted to assist in development, construction and maintenance of the site.

Phase 2: Asynchronous and Synchronous Intervention Protocols (Health IT Intervention)

IS personnel trained all study personnel regarding pertinent software and hardware issues. Dell and HP desktop and laptop computers, cameras and headphones/mics were purchased for the study and dispensed to each participant for the duration of their participation. During recruitment, a checklist regarding in home technology access and basic computer literacy was completed. Once enrolled, the initial technology instructional session was conducted within the participant's home. The study coordinator and IS personnel set up the hardware; loaded the software; tested the Internet systems (point to point connection speeds and Web-portal access) and oriented the participant and parent/caregiver. A second remote test session was scheduled.

Therapy sessions:

Voice Protocol:

Three certified experienced speech language pathologists provided 8 personalized physiologic voice therapy sessions with each participant. All pediatric voice therapy sessions included a review of the previous week's work; vocal hygiene; and participant's voice care and use followed by direct therapy exercises which included practice phrases and discussion time.

At the beginning of each participant's synchronous treatment session, the participants were called using MOVI teleconferencing system. The MOVI system used two Web cameras; one at the patient's end and one at the clinicians end. The participant and clinician were seated in front of the computer and camera. Noise-reduction ear phones and microphone were worn by both participant and clinician. After the connection was established, introductions were followed by an introduction or announcement of whether anyone other than those scheduled to be at the session were present. Per standard therapy, a conversation with participant and parent/guardian regarding progress or problems took place. Visual and audio feedback from the clinician was provided. Images, voice samples and documents were shown, as needed. New exercises were introduced, if required.

In summary, each session included:

Vocal Hygiene: Designed to promote appropriate vocal use and care. This includes suggestions regarding improving hydration and avoiding harmful vocal behaviors and environments.

Vocal Exercise: As appropriate, we clinicians used a series of voice exercises considered a modified version of Vocal Function Exercises[35] and designed to have the individual achieve optimal breath support, glottic tension and resonance for conversational voice. One component of the vocal exercise program is repeated pitch glides. The key feature is that the individual sustains multiple musical notes that are closely matched to his/her comfortable or target fundamental frequency (e.g. C, D, E) on a single breath of air using the vowel "o". The range of notes practiced was based on the individual's ability to alter pitch.

Resonance Exercise: This exercise program is a modified version of Resonant Voice Therapy as described by Verdolini.[36] This group of exercises is designed to improve the resonant focus (reducing excess laryngeal tension) of an individual's voice. These are particularly well suited to reducing excessive laryngeal tension, a common problem in

childhood voice disorders particularly those related to airway reconstruction. Once the individual was able to replicate the oral focus while humming, words and short phrases are introduced to begin the transition to incorporating this technique into conversational speech**.**

Web-Portal Independent (or parent assisted) Practice Sessions (Health IT Intervention)

Any form of therapy or exercise regimen requires a structured practice component. Home practice took place through www.myvoicecare.org. Individualized practice goals were determined during the synchronous therapy sessions. At the end of each weekly synchronous session, the voice clinician directed the participant and their parents/caregivers to any advancement or modifications of the Webportal exercise levels. The home practice sessions were designed to last approximately 10-15 minutes.

Clinicians, participants and parents/guardians were asked to complete daily and weekly practice logs and data sheets. The Web-portal had data collection pages corresponding to 1. compliance with voice care guidelines and 2. Technology stability. Materials were adjusted for age. The video and audio files uploaded were available to act as samples.

Results

Principal Findings-Outcomes

Following is a summary of preliminary feasibility results available to date. As we are within two months of this study's completion, the full range of data (including the final 3 participants) gathered during the course of the study has not yet analyzed. Formal analyses are forthcoming.

SA1: The first specific research question for SA1 was: What were the average ratings expressed as per of technology stability per participant and clinician, for each type of access (synchronous and Web-based) across 8 sessions? We also examined each of the technology components (connection speed; audio; video; and ease of use).Tables 2-6 summarize the technology use and satisfaction related data. Each question was posed via the Web portal and used a 5 point Likert scale ranging from failed (1), poor (2), fair (3), good (4), and excellent (5).

Table 2. Participants final average rating of overall Internet (synchronous session) video and audio quality (N=7).

Participant Sync Video Quality	**Percent**
Excellent	38
Good	62
Participant Sync Audio Quality	**Percent**
Excellent	38
Good	62

Table 3. Participants final overall rating of ease of Internet use during (synchronous) sessions (N=7)

Participant: Overall use of Internet Rx	**Percent**
Very Easy	69
Easy	31

Table 4. Clinician (N=3) average final rating of overall Internet based audio and video quality during synchronous sessions for 7 participants x 8 weeks of therapy.

Clinician Sync Video Quality	**Percent**
Excellent	5
Good	63
Fair	24
Poor	2
Failed	5

Clinician Sync Audio Quality	Percent
Excellent	5
Good	44
Fair	37
Poor	15

Table 5. Clinician (N=3) average final ratings of ease of use for providing Internet based therapy for 7 participants x 8 weeks of therapy.

C Sync Internet Therapy	Percent
Very Easy	7
Easy	66
Adequate	20
Difficult	2
Difficult	5

Table 6. Participant average final rating of Web portal audio and video quality (N=7)

PWebAudioQuality	Percent
Excellent	38
Good	62
PWebvideoquality	**Percent**
Excellent	28
Good	72
Poor	1

We also examined components the most common reasons for technology related problems for the participant and for the clinician across the 8 sessions. At the beginning of each session, families were directed to an Internet speed (ISP) assessment site (e.g. www.speedtest.net) to get their current up/download speeds. For the participants whose data are included above (N=7), ISP speeds averaged 1.02 Mbps (range: .63-1.98Mbps).

Several of our calls did experience periodic connection interruptions or failures. The primary reason for this was that despite our best planning, many of the eligible participants had lower or variable consumer connection speeds. We lowered the criteria originally established by our IS planning team in order to truly determine feasibility. Following is a description of technology related issues and solutions employed:

- Original set (December ’12 – February ’13) of connection/call quality issues was caused by default Jabber setting requesting 1Mbps per call.
    - Some of the participants involved weren’t working with sufficient upload speeds to match our requested 1Mbps it caused significant freezing, call failure, and or degradation.
    - After testing with Cisco engineers we determined that the Jabber application would attempt to aggressively down throttle when it didn’t receive the requested 1Mbps and had substantial trouble recovering. Often causing the call to drop or produce issues.

    - We then determined that we could manipulate the requested speed value of our Jabber users. Working off normative speed increments we began to test by notching down one level at a time. First at 768Kbps, then 512Kbps, then 384Kbps. Since Cisco won't support Jabber calls below 384Kbps we used that to create minimum threshold for speed.
    - What we then found was that we could leave our internal callers (Callers that connected within CCHMC network boundaries – non-VPN) at 768Kbps requested value and dependent upon the speeds that were turned in by patient participants we found that moving them into requested speed levels of 512/384 produced desired results.
- A second set of issues occurred as CCHMC IS took on a complete upgrade/overhaul of the CCHMC Telemedicine Network that would assist us in moving toward the cutting edge of web and video conferencing. Our system is so new that our vendor partner hadn't completed an upgrade that would see all of these components moved to the newest version at the same time. While we understood that this would offer us the most advanced system there were some unknowns. One of the ways this surfaced in our study was when IS found out that the new Jabber didn't adopt the bandwidth containers that we had previously built for your study to use that reduced the amount of calls that "froze". Once we pinpointed the problem we recreated the containers and assigned them to each of the current participants involved in the study which yielded acceptable quality.
- Additionally, it was thought that the old Jabber client would continue to operate throughout the upgrade so we decided to not roll-over the study to minimize interruptions. IS was surprised to find out that it wouldn't work and an immediate roll-over needed to take place which caused the issues above. This impacted the final sessions of the final 3 participants.

SA2: For this aim we collected participant, parent and clinician satisfaction data across multiple domains. The satisfaction data were collected at weeks 4 and discharge. The compliance, cost and treatment modification data will be collected for each week of treatment. Our specific questions included:

- Do the satisfaction survey data as reported by parents, child participants and clinicians reflect trends in previously published telehealth studies for the fields of speech language pathology and psychology? Tables 7-10 summarize the available data.:

Table 7. Parent rating of Web portal burden of use (N=7)

Parent report of use of Voice Web: Burden	**Percent**
Very little	100

Table 8. Parent ratings of recommendations for use of telehealth and for comparison of TH with face to face treatments (N=7).

Parent Recommend Telepractice	**Percent**
Excellent	12.5
Good	87.5
Parent Compare Face to Face	**Percent**
Excellent	50
Good	50

Table 9. Clinician (N=3) final rating of telehealth experience for 7 participants x 8 weeks of therapy.

Clinician Recommend Telepractice	**Percent**
Excellent	12.5
Good	87.5

Table10. Clinician (N=3) final rating of providing Internet based and face to face treatment sessions for 7 participants x 8 weeks of therapy.

Clinician Compare Face to Face	**Percent**
Good	100

Table11. What is the average compliance rate reported by parents for Web based home practice sessions?

Parent report child compliance	**Percent**
A lot	89
Quite a bit	11

The questions regarding cost savings have yet to be analyzed. Parents reported to us that being able to participate in therapy from home was an enormous burden relief. Post treatment interview comments included:

- TH was very convenient
- TH added to their overall QOL
- Their child enjoyed using technology to participate in therapy
- Several participants wanted to continue or be asked back

  - Three families indicated they would not want to participate in therapy any other way or they could not have done it any other way because of the burden on the family to manage schedules and travel to the city.
  - Two families indicated they did not want to come into the (a) clinic and expose their child (and his/her siblings) to “bugs”
  - All felt their children benefitted
  - Some participants expressed some aggravation with technology but were will to persist due to convenience and access to specialist care.

Clinicians also expressed strong support of the experience but were more critical of the technology support and noted some concerns with acoustic fidelity of the sustained voice signal during Internet sessions. Comments included:

- Clinician reported episodic tech issues (ISP issues; other)
  - Cisco Jabber internal settings had to be adjusted down for consumer ISP speeds
  - Episodes of audio and video freezing
  - Occasional muffled sound quality and degradation of sustained voice signal
  - Call connection issues
- All felt they delivered more efficient, focused sessions when compared to face to face sessions.
- A limited number of adaptations were required to achieve a successful therapy exchange including:
  - The clinician working to maintain “eye contact” with the child.
  - Adjusting the pragmatic exchange to accommodate slight lag in voice transmission.
  - No difficulty managing the child’s behavior was reported.
  - Parents were available for discussion as per face to face sessions.

Discussion:

Ten pediatric participants (and their families) each successfully completed 8 weeks of synchronous and asynchronous management of their communication disorder. No one dropped out of the study or had an unfavorable assessment of the experience. All the families indicated that the children benefitted from the experience and moreover, their voice disorder was resolved or managed to a satisfactory degree. Several families highly recommended the experience and noted it had a positive impact on their family's well-being. The participating clinicians in the study also highly rated their ability to manage this type of communication disorder via these methods and wish to continue to have the opportunity to do so. They were concerned however with periodic technology interruptions, particularly those that had to be managed at multiple levels. This, in some small part, reflected the need for IS and clinical personnel to develop an improved model of interdisciplinary collaboration as is seen elsewhere in healthcare.

There are acoustic fidelity issues with regard to transmission of human voices via the internet (e.g. signal compression issues during sustained voicing) that need further investigation. Although this study did not rely on internet transmission of voice data for formal diagnostic purposes, clinicians are continually making perceptual assessments regarding their patient's voice or speech quality. Not understanding the limits of signal transmission can impact subtle but important differences in sound perception. This can be partially overcome by recording and uploading files, as was done in this study (Web portal).

The use of an interactive Web portal to assist in the management of the patient in their home environment has not been done before in the area of pediatric voice disorders. This system offered multiple options for assessing and advancing patient progress in an asynchronous fashion. It also provided us the opportunity to directly observe the participant's adherence to our prescribed therapy programs. The families were fully informed of this fact. The ability to individualize treatment approach while maintaining security and data collection has implications for advancing our understanding of how individuals (children and adults) adhere to behavioral programs. Adherences levels are often linked to outcomes. We certainly acknowledge that there are numerous healthcare applications sending streams of data to clouds everywhere but use of an interactive Web portal such as the one built for this study in our view, offers a reasonable compromise of data management and healthcare guidance.

Conclusions:

Although our full and formal analyses of all captured data are forthcoming, our current assessment is that this type of hybrid technology (face to face; asynchronous and synchronous) can and should be used to deliver hospital to home behavioral *therapy if there is sufficient preparation, training and execution on the part of the clinician and consumer.* There is enormous potential to facilitate the delivery of several other types of behavioral therapy services to children and teens. Although our project focused on the delivery of voice therapy, other communication/cognitive/swallowing impairments (e.g. speech sound disorders, fluency, feeding/swallowing, cognitive-behavioral) could be managed via these systems. Families, regardless of their personal status, now have the expectation that technology should be used as a routine means by which to access certain types of healthcare. Our findings also suggest that "access to care" extends beyond geographic obstacles. Access to care also encompasses ordinary day to day obstacles families of all situations encounter when trying to navigate and integrate their child's heath care needs into the broader needs of the family.

Implications and Significance:

Delivering therapy via the Internet into the home is truly the frontier of telehealth. Because of the variable nature of the healthcare consumer's personal technology and regional services, mismatches in system requirements remain potential problems. However in our view this factor will diminish in time with improved initiatives between healthcare and IS providers which could result in a more evenly accessed, affordable ISP across consumers. Of note, our one rural participant had the best quality and fastest ISP and may be a reflection of the state and federal initiatives to create "smart" rural communities. Lastly, delivering behavioral services via the Internet represents a paradigm shift for many clinicians. The popular assumption is that distance has a negative impact on the care of individuals. Our findings suggest otherwise. Both clinicians and consumers are anxious to continue to explore and study this option.

Citations for Scope and Background

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Publications and Products

As we are just completing this project, only one proceeding and one informational article have been published. This project has been presented numerous times to national and international audiences (see previous AHRQ reports). It will be presented at the American Telehealth Convention in Los Angeles, May 2015 (oral platform presentation).

1. Kelchner L: Access to pediatric voice care: A telehealth solution. 10th International Conference: *Advances in Quantitative Laryngology, Voice and Speech Research Proceedings*, June, 2013; 11-12.

2. Kelchner L: Telehealth and the treatment of voice disorders: A discussion regarding evidence. *Perspectives on Voice and Voice Disorders,* American Speech Language and Hearing Association. 2013; 23 (3), p. 88-94.

Planned manuscripts:

1. **Keeping the touch in telehealth: A qualitative assessment of providing pediatric voice therapy using a hybrid model of service delivery.**
2. **Construction and implementation of an interactive Web portal designed to support progress in pediatric voice therapy.**
3. **The feasibility of delivering pediatric voice therapy via telehealth: A new concept in accessing specialized care.**
4. **The Telehealth Frontier: Providing pediatric behavioral therapies into the home.**
5. **Adherence and compliance in pediatric voice therapy: Lessons learned.**