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Telepractice in the Treatment of Speech and Voice Disorders: What Could the Future Look Like?

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ABSTRACT

Purpose: There is an ongoing technological revolution in the clinical tools used by speech-language pathologists (SLPs) to care for patients. The COVID-19 pandemic accelerated the pace of change and the shift to telepractice. Telepractice will continue to play a large role after the pandemic, but it is unclear what the future may look like. Our goal is to give SLPs an overview of how recent technological innovations may enhance synchronous treatment, enable asynchronous treatment, and broadly modify traditional clinical practice patterns while the patient spends less time in the clinic.

Conclusions: Newer telepractice tools such as remote patient monitoring, digital phenotyping, virtual reality, and artificial intelligence may improve the therapeutic process by addressing the shortage of SLPs and the transition of therapy practices to the real world. We also highlight key barriers to this future, including lack of rigorous trials of advanced technologies and state licensure regulations.

The COVID-19 pandemic has driven a dramatic rise in the use of telehealth. Within telehealth is telepractice, a term used by the American Speech-Language-Hearing Association (ASHA) to include remote services outside traditional settings. Speech-language pathology services are particularly amenable to telehealth delivery, given the audiovisual nature of clinical interactions and techniques (Theodoros, 2013). Not surprisingly, speech-language pathologists (SLPs) shifted a substantial fraction of visits to telepractice during the COVID-19 pandemic (see Figure 1; Patel et al., 2021).

Although certainly not universally accepted across all patients with speech and voice disorders, telepractice is often well received by these patients. In some cases, remote visits are rated as higher quality than in-person services due to enhanced convenience and reduced travel (Cason & Cohn, 2014; Hall et al., 2013; Keck & Doarn, 2014; Regina Molini-Avejonas et al., 2015). Telepractice will continue to play an important role in the future of SLP treatment delivery, but what might that future look like? Leveraging our experiences in working with patients with speech and voice disorders and expertise in telehealth, our goal in this article is to introduce SLPs to a few developing telepractice technologies and to posit a vision of how they might fit together, as they prepare for the future of telepractice in a post–COVID-19 world. We hope the article continues the debate about what the future of SLP practice patterns may look like.

Two Fundamental Challenges in the Field of Speech and Voice Therapy

Before turning to telepractice, it is important to highlight two fundamental challenges currently facing the field of speech and voice therapy that telehealth could help address. First, there are simply not enough SLPs. This lack of supply is possibly best represented by the scarcity of SLPs who subspecialize (Squires, 2013). According to ASHA (2022), there are only 668 subspecialists (0.5% of all SLPs; U.S. Bureau of Labor Statistics, 2022), and there is only one SLP who specializes in stuttering for every 20,833 persons who stutter in the United

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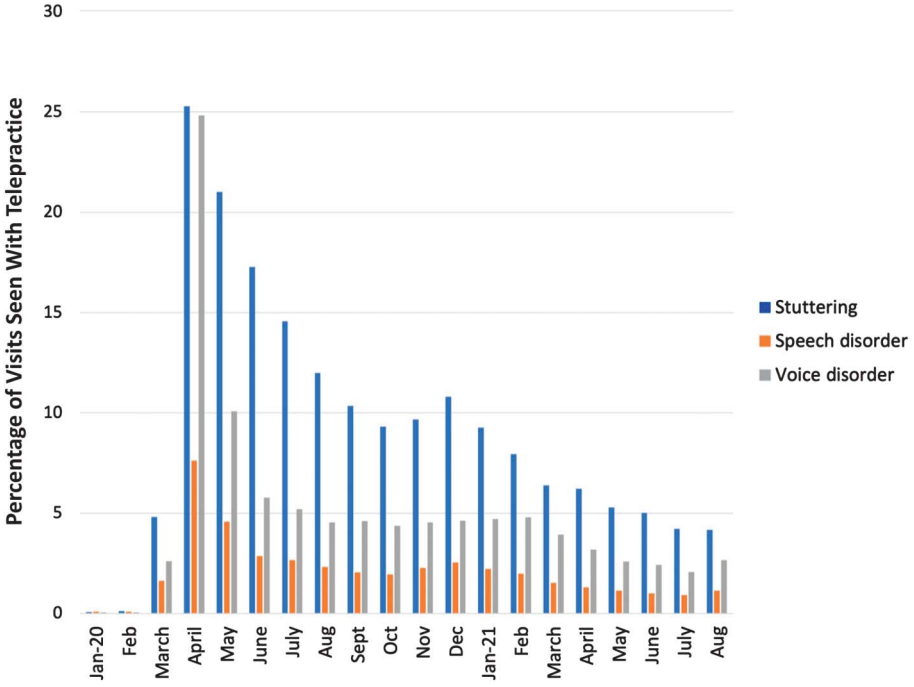
Figure 1. Fraction of visits in a given month provided via telepractice in speech therapy during the COVID-19 pandemic. Data retrieved from a database of 16.7 million commercially insured and Medicare Advantage enrollees. See Patel et al. (2021). Utilized International Classification of Diseases-10 diagnostic codes include F80.81, F80.89, F80.9, F80.0, F98.5, R47.82, J37.0, J38.0, J38.01, J38.1, J38.2, R49.0, and R49.1.



States (Coalson et al., 2016). In addition, many SLPs are geographically concentrated in urban areas, posing a significant barrier to access care among rural residents (Verdon et al., 2011). Under the current practice model, receiving care from an SLP can be quite time intensive. For example, many outpatient SLP diagnostic or treatment sessions for patients with speech or voice disorders typically last between 30 and 60 min per patient (Zhang et al., 2022). In addition, the travel time incurred by patients for each session poses a significant barrier that limits access to care. A second challenge is the generalization of speech and voice therapy to the real world—the well-known carryover problem (Ziegler et al., 2014). It is very common for patients with speech or voice disorders to dramatically improve in the clinical visit but subsequently struggle in day-to-day interactions. Emerging telepractice tools can help address these challenges by helping SLPs treat more patients across a broader geographic area and allowing diagnostics and treatment to be more fully integrated into a patient's daily communication situations.

Four Emerging Tools With Potential to Facilitate and Enhance Telepractice

Artificial intelligence-driven technologies have potential to accurately measure clinically important constructs from patient video and audio clips. Automatic speech recognition methods have been shown to help characterize various speech disorders in children (Hosom et al., 2004) and outperform human listeners when assessing adult dysarthric speech (Green et al., 2021). Thus, it is conceivable, that in the future, patients' intelligibility could be automatically and objectively evaluated during an in-person or remote therapy session. These data could be aligned with the clinician's perceptual evaluation and various treatment techniques, helping the SLP better understand which ingredients had larger or smaller impacts on their individual patient's intelligibility. Eulerian video magnification (Wu et al., 2012) is another artificial intelligence tool that can measure physiological signals too subtle for the human eye to reliably perceive. Thus, it could become useful in alerting clinicians during treatment of any changes in patients' physiology (e.g., heart rate variability) related to emotional states (e.g., frustration and stress; Thayer et al., 2012). For example, an artificial intelligence algorithm using Eulerian video magnification data could identify high levels of physiological stress in the patient. At which time, the algorithm could alert the clinician and the treatment can be made less stressful by moving to a lower difficulty hierarchy (e.g., practice easier words or shorter phrases), providing higher doses of cueing (e.g., have the child repeat after the clinician instead of generating the word by themselves), or taking a

short rest. The clinician could also be provided feedback in real time regarding the effectiveness of their treatment modifications, such as whether or not the patient's stress signals reduced. SLPs will obviously need training with these new technologies and the amount of training burden will likely depend upon the usability of each software's user interface.

A second category of tools uses digital phenotyping (Insel, 2017) or the moment-by-moment quantification of the individual patient's symptoms outside a clinical visit, to both monitor and adjust treatment. This is common in other clinical areas. For example, cardiac electrophysiologists monitor atypical heart rhythms remotely through implantable devices such as pacemakers or automatic implantable cardioverter-defibrillators (Halcox et al., 2017). The information is sent to their physicians regularly and medication regimens can then be adjusted based on the findings. Such a framework can be used in speech therapy. Hillman and colleagues developed an ambulatory voice monitor, which consists of a miniature accelerometer taped to the neck skin and connected to a smartphone, that can provide personalized diagnostics regarding a patient's voice use in daily life (Van Stan et al., 2020, 2022; Van Stan, Ortiz, et al., 2021). Also, this monitor can essentially increase the amount of therapy provided by providing biofeedback to the patient in his/her daily life. Summaries of such ambulatory biomarkers can be remotely sent to SLPs at desired time intervals, who could then provide feedback to the patient and/or adjust the biofeedback settings outside of or during a telehealth visit. Remote data such as this can help identify real-life situations where the patient is struggling most and tailor treatment to better address those difficult contexts. It may also increase clinical efficiency, as many parts of a clinical assessment could be completed in the patient's daily life instead of a dedicated 30–60 min block of time. This would open up more treatment time in an SLP's schedule.

A third technology is virtual reality (VR), which can allow people with speech and/or voice disorders to practice communication in simulated real-life situations. One company called "withVR" (Walkom, 2016) has developed a VR platform that enables patients to practice customizable speaking situations in a safe place and to receive more frequent feedback from "real-world" encounters, enhancing the transition of therapy techniques outside the clinical visit (Šalkevičius et al., 2019; Walkom, 2016). Preliminary results indicate a reduction in anxiety among persons who stutter after practicing speaking with the technology. Multiple research groups are developing audio VR systems that can simulate different room acoustics (Lentz et al., 2007). Future patients could practice with these tools asynchronously outside the therapy session. SLPs could assign a home program where the patient can practice their voice or speech exercises in situations that are stressful (e.g., public speaking or reading) or environmentally difficult (e.g., very high or low room reverberation).

A fourth technology is gamification, which could better engage patients in the therapeutic process and obtain measures of adherence and accuracy to home exercise. Stamurai is a mobile application that supplements telepractice by allowing children to practice their speech with over 300 personalized exercises that measure fluency, prolongations, and emotional health (Team Stamurai, 2020). Recently, Vocal Function Exercises (an evidence-based voice treatment; Angadi et al., 2019) was transformed into a voice-controlled computational model of a floating ball, where patients can practice voicing based on quantitative feedback (Van Stan, Park, et al., 2021). Since this gamification of Vocal Function Exercises is completely quantitative and based on motor control/learning research, it can provide objective measures of at-home practice adherence and practice accuracy (Van Stan, Ortiz, et al., 2021). Such gamification can give high-quality, quantitative feedback in real time without the SLP needing to provide it. As is common in behavioral therapies, it is estimated that 30%–65% of patients are nonadherent and/or drop out of voice therapy (Hapner et al., 2009; Portone et al., 2008; Portone-Maira et al., 2011). Gamified therapy tasks have been shown to improve adherence in multiple rehabilitation studies, with large statistical effect sizes (Brown et al., 2016; De Croon et al., 2021; Richards & Caldwell, 2017; Tran et al., 2022). Combined with the high-quality real-time feedback at home and the possibility of improved adherence, gamification may significantly improve voice and speech therapy outcomes.

A Vision for How These Different Tools Might Fit Together in the Future

We envision a future where SLPs spend less time on individual visits and much more time on the use and interpretation of patient data to adjust treatment. Patients will be "prescribed" technologies—such as ambulatory monitoring hardware to combine with their own smartphone, audio VR headphones, hardware and software to perform exercises in a video game on their home computer—that are integrated into virtual telehealth platforms, essentially facilitating many speech-language pathology services from the brick-and-mortar clinic into the patient's real world. Practice apps can be used to help the patient practice and progressively improve based on quantitative feedback and gamification. In such a scenario, SLPs would spend much of their day reviewing data from ambulatory hardware, software, and games, then translating these into a diagnosis and a treatment plan.

Instead of measuring interactions in visits, there will be a shift to "touchpoints," which could occur much more frequently than the current practice of one to two sessions per week. For example, the first therapy session might be a traditional length to educate and counsel the patient about their disorder and treatment approach as well as

improve and shape the patient's performance. But then, for some patients, treatment could transition to touchpoints including text messages or short exchanges in virtual platform to modify a patient's ambulatory voice biofeedback device (Van Stan et al., 2022), answering a patient's clinical question, providing feedback or information about the patient's home practice, and so forth. While increased touchpoints may be the future of telepractice, we want to highlight that the role of an SLP often includes services that require longer sessions, such as the establishment of correct production, modification and hypothesis testing during treatment, and counseling. Balancing touchpoints with these more time-demanding services may become the reality. Potentially, these touchpoints would be paid through a capitated monthly fee and an individual SLP would spend less time per patient but be in touch with them much more frequently.

How This Future Could Address Fundamental Challenges in the Field of Speech and Voice Therapy

In this vision, a single SLP can serve a much larger number of patients across multiple states, which would help significantly with patient access to SLPs. Such a shift could also facilitate greater specialization among SLPs by enabling the treatment of specialized patients in a much wider geographic area. For example, rural health systems have invested heavily in telepractice—seeing it not just as a way to fill gaps in services but to enable team-based care delivery using a hub-and-spoke model. The integrated delivery system, Avera Health, provides telepractice services to a network of more than 130 rural clients across geographies from a virtual hospital based in Sioux Falls (Mackinney et al., 2015). Avera Health's eCARE hub offers rural hospitals access to specialized health care professionals, including SLPs, who are available at all hours to provide support to facilities that might not otherwise be able to recruit or retain such providers (Mackinney et al., 2015). In doing so, telepractice enables specialized treatment of individuals by drawing upon the expertise of SLPs across geographical lines.

Transitioning to a "touchpoint" system that incorporates data collection during treatment, home practice, and in the patient's daily life has potentially substantial benefits for carryover difficulties. Much more of the patient's assessment and treatment experience will occur in their daily life, outside of the therapy session. Currently, clinicians run 30–60 min in-clinic assessments with questionable applicability to the patient's daily life. Instead, ambulatory assessments could acquire much more data from the patient in the patient's daily life while also requiring much less clinician time. Arguably, compared with the traditional in-clinic assessment, an assessment based on measures from daily life has better odds of creating treatment goals with more carryover. Translating these technologies into clinical practice may not necessarily reduce the amount of practice and feedback with the clinician in real time. However, it could dramatically increase the total dose of therapy through more home practice and feedback with asynchronous clinical supervision. Increased practice and feedback in the desired functional context have demonstrated improved carryover and generalization in motor learning studies (Schimdt & Lee, 2014).

While this vision may sound too futuristic, it is important to recognize that these shifts are already happening in other areas of medicine and speech and language therapy. The Food and Drug Administration has approved artificial intelligence tools that diagnose retinopathy from retinal images (Lee et al., 2021). Endocrinologists now regularly monitor their patients with diabetes using continuous glucose monitoring, and there has been rapid growth among primary care doctors in remote monitoring of patients with hypertension (Drincic et al., 2016; Logan et al., 2007).

Barriers to the Future Vision of Telepractice in Speech and Voice Disorders

Despite the advantages outlined previously, we recognize that there are many barriers that need to be addressed before this future could be realized. Given the scope of this article, we only briefly touch upon these barriers. First, there is a significant need for access to broadband Internet services, which is widespread but not yet universal. Second, many of the technologies mentioned in this article are currently in development and require rigorous testing and deployment in real-world trials prior to widespread adoption. Future studies may apply these technologies to real-world settings and rigorously assess quality metrics. For example, the impact of VR technology on improving fluency in speech disorders would have to be quantified and the "touchpoint" model would have to be rigorously tested before widespread adoption and reimbursement potential.

Third, requiring an SLP to be licensed in every state in which they treat patients has become archaic in the era of telepractice and is a major barrier to the universal adoption of telepractice (Mehrotra, Nimgaonkar, & Richman, 2021). To provide care across state lines, SLPs must obtain and maintain multiple state licensures—an arduous and costly task. Recent proposals have been presented to enhance license portability and reduce regulatory barriers to telepractice. For example, ASHA instituted the Audiology and Speech-Language Pathology Interstate Compact, an agreement to expedite the medical licensure processes among member states. They have achieved success in operationalizing the compact and developing a database to interface with state licensing boards. The

compact commission is expected to issue privileges to practice in 2023—a major step forward. Although these actions are a step in the right direction, it would still require substantial administrative burden for an SLP to practice across many states.

A fourth barrier is reimbursement. During the COVID-19 pandemic, most public and private payers expanded coverage to telephone and videoconference visits for all patients with speech disorders, including in their homes for the very first time (Mehrotra, Bhatia, & Snoswell, 2021). While these changes were promising, it is still unclear if they will continue when the pandemic slows and finally ends. There will also need to be a shift in how SLPs are paid. Instead of paying for each visit, this model would be supported by a monthly payment to the SLP for managing the care of a patient. Such monthly payment models are already being used by Medicaid, Medicare, and private insurers in other areas of health care.

Conclusions

The integration of new technologies into telepractice has the potential to dramatically increase access to care for the many Americans who need effective speech therapy but currently cannot receive it. Furthermore, it has great potential to improve the efficiency of SLP clinical services. We hope that this article sparks a conversation and debate among SLPs about the future of telepractice, as they continue to advance telepractice in a post–COVID-19 era.

Data Availability Statement

Data retrieved from a database of 16.7 million commercially insured and Medicare Advantage enrollees. See Patel et al. (2021).

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