Examining Use and Effectiveness of Teletherapy for Patients with Dysphonia

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SUMMARY: Objective(s)/Hypothesis. Virtual therapy (teletherapy) for patients with dysphonia has become ubiquitous in the COVID-19 era. However, barriers to widespread implementation are evident, including unpredictable insurance coverage attributed to limited evidence supporting this approach. In our single-institution cohort, our objective was to show strong evidence for use and effectiveness of teletherapy for patients with dysphonia.

Study Design. Single institution, retrospective cohort study.

Material and Methods. This was an analysis of all patients referred for speech therapy with dysphonia as primary diagnosis from 4/1/2020 to 7/1/2021 and in whom all therapy sessions were delivered in a teletherapy format. We collated and analyzed demographics and clinical characteristics and adherence to the teletherapy program. We assessed changes in perceptual assessments and vocal capabilities (GRBAS, MPT), patient-reported outcomes (V-RQOL), and metrics of session outcomes (complexity of vocal tasks, carry-over of target voice) pre- and post-teletherapy using student's *t* test and chi-square test.

Results. Our cohort included 234 patients (mean [SD] age 52 [20] years) residing a mean (SD) distance of 51.3 (67.1) miles from our institution. The most common referral diagnosis was muscle tension dysphonia (n = 145, 62.0% patients). Patients attended a mean (SD) of 4.2 (3.0) sessions; 68.0% (n = 159) of patients completed four or more sessions and/or were deemed appropriate for discharge from teletherapy program. Statistically significant improvements were seen in complexity and consistency of vocal tasks with consistent gains in carry-over of target voice for isolated tasks and connected speech.

Conclusions. Teletherapy is a versatile and effective approach for treatment of patients with dysphonia of varying age, geography, and diagnoses.

Key Words: Dysphonia−Virtual−Teletherapy−Speech therapy.

Abbreviations: GRBAS, grade, roughness, breathiness, asthenia, strain−IRB, institutional review board−MPT, maximum phonation time−PPE, personal protective equipment−SLP, speech-language pathologist−VHI, voice handicap index−V-RQOL, voice-related quality of life.

INTRODUCTION

Voice disorders are common in the general population, with an estimated lifetime prevalence as high as 30%.[1,2] Associated individual and societal burdens are substantial, with deleterious impacts on quality-of-life and social interaction, workplace productivity, and healthcare costs.[3] Voice therapy as delivered by a speech-language pathologist (SLP) is recognized as a core or primary treatment for many causes of dysphonia. Targeted goals range from curative to compensatory based on etiology along with a number of other patient-specific factors. Positive outcomes can be quantified in various ways, including through measurement of change in perceptual ratings, acoustic, and aerodynamic parameters, and personal satisfaction with voice and/or voice function.[4,5]

Recently, the feasibility and efficacy of delivering voice therapy in a virtual format (ie, teletherapy) for patients with dysphonia have been re-examined in earnest as the required technology for this care has become more widespread.[6,7] Teletherapy for patients with dysphonia has numerous advantages, including: enhanced convenience,[6] broader accessibility across a large patient catchment area,[7] enabling providers to see more patients in each clinic,[8] and continued mitigation of COVID-19 transmission risk.[9] The use of teletherapy to treat voice disorders remotely was first described around the turn of the 21st century.[10,11] These initial small case series suggested that teletherapy was feasible, practical, and comparable to traditional in-person formats for care delivery. In the 2010's, progressively more case series emerged showing objective improvement in perceptual, acoustic, and physiological voice metrics as well as high patient satisfaction with teletherapy across a wide range of vocal pathologies.[6,12] By 2020, many in the field recognized the potential unique benefits of teletherapy for voice disorders, including improved accessibility and availability of care, costeffectiveness, and patient satisfaction.[13] However, widespread utilization of teletherapy for patients with dysphonia had not yet been realized.

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There is a growing body of literature supporting feasibility and efficacy of teletherapy for patients with dysphonia.[8,9] However, concerns such as inconsistent payer reimbursement and lack of confidence in this approach among providers currently limit widespread implementation.[14] The aim of this retrospective study was to investigate, in a large single-institution cohort of patients with dysphonia, the feasibility, use and effectiveness of teletherapy.

MATERIAL AND METHODS

This study was deemed exempt from formal review by the Michigan Medicine IRB (HUM00188222).

Patient population

We first identified all patients presenting to the Michigan Medicine Vocal Health Center for initial evaluation by a SLP from 4/1/2020 to 7/1/2021. Patient charts were manually screened by the first author to include only those patients newly referred for SLP services for a primary diagnosis of dysphonia and in whom all voice therapy sessions were subsequently delivered in a virtual (ie, remote) format. Because of established standards for reimbursement, only those patients residing within the state of Michigan during teletherapy were included. Due to the multidisciplinary nature of our clinic, we included patients who had an initial in-person voice evaluation with all subsequent voice therapy sessions delivered virtually. Patients seeking to re-establish care (ie, initial evaluation with or without therapy sessions) previously halted by the start of the COVID-19 pandemic were excluded from the analysis.

Demographic and clinical characteristics

From the electronic medical record, the first author (J.D.S.) collated all variables of interest from each individual patient. Data was tabulated in a standard Excel spreadsheet and data missingness was explicitly recorded. For each patient in our final cohort, we collected the following variables: age, sex, ethnicity/race, home address, distance from home address to Michigan Medicine, quantity and date(s) of teletherapy sessions, total duration of teletherapy over time, number of no-shows and cancelled teletherapy sessions and etiology of dysphonia. Distance from patients' home address to Michigan Medicine was calculated in miles using Google Maps (Google LLC, Mountain View, California, USA). Etiology of dysphonia was recorded from the laryngologist's documentation and grouped as described.[15]

Description of teletherapy program

All virtual care was provided via the Zoom platform (Zoom Video Communications, San Jose, CA) within a secured internal network under the authors' institution patient portal. Patients were allowed to use any compatible audio-video device, though were encouraged to use a laptop or computer with dedicated camera and microphone. Patients were provided with a standardized institutional handout on how to register for the patient portal and install and test the Zoom platform software. Additional personal telehealth instruction/walk-through was occasionally performed with the patient by the treating SLP at the time of the initial patient evaluation. The authors' institution also employs a dedicated telehealth technical support team where patients can call for assistance if technical difficulties are encountered at the time of their appointment.

Four SLP (K.M., M.R., E.B., and M.T.) conducted the teletherapy sessions described herein. The time interval between sessions was variable and tailored to individual patients' needs. All have specialty training in evaluation and treatment of complex voice disorders with expertise in delivering traditional in-person voice therapy techniques including semioccluded vocal tract tasks, resonant voice therapy, and vocal function exercises. Patients' initial voice evaluation consisted of standard assessment of voice concerns, voice use, and social and occupational voice demands as well as relevant counseling on vocal hygiene (eg, adequate hydration, reflux mitigation strategies, voice rest). Dependent on individual clinician preference, the voice-related quality of life (V-RQOL) measure was additionally administered, and normalized calculated total score was recorded (0-100 scale with higher scores indicating subjectively better voice quality).[16] Similarly, the clinicians frequently, though not uniformly, used the GRBAS scale to complement formal auditory perceptual assessments.[17] Additional assessments included measurement of maximum phonation time (MPT) on sustained /a/ vowel at comfortable pitch and loudness, and S/Z ratio, per clinician preference.[18] At the conclusion of an initial voice evaluation, clinicians shared structure, timeline, and goals for planned teletherapy program and ensured patients had sufficient technological resources and support required for sessions.

Voice therapy programs are traditionally eclectic in that specific targets and components of therapy are often based upon individual patient evaluation, therapeutic probes, and response to treatment.[19] For most teletherapy sessions, like in-person sessions, patients were guided through vocal tasks across a hierarchy of complexity, categorized from least to most complex as (1) isolated/sustained sounds; (2) syllables; (3) words/structured phrases; and (4) conversational speech. To evaluate increasing accuracy for target voice in everyday speech settings, our clinicians assessed carry-over of target voice both for isolated tasks and connected speech.[20] This was quantified in categories as none, emerging, variable, or stable. Complexity of vocal tasks and carry-over of target voice for isolated tasks and connected speech were measured consistently at each teletherapy session by assessing overall accuracy of tasks in gradually longer and more varied utterances, consistent with structure described in extant literature.[19-21] Each clinician provided patients with educational materials and instructions for at-home exercises to be completed between teletherapy sessions.

Assessment of teletherapy outcomes

Two-tailed student's t test ($\alpha = 0.05$) was used to evaluate change in mean V-RQOL calculated total score, GRBAS ratings, MPT and S/Z ratio from initial in-person evaluation to last documented teletherapy session. Chi-square test ($\alpha = 0.05$) was used to compare proportions of patients within each vocal task complexity level pre- and post-teletherapy. Change in carry-over of target voice for isolated tasks and connected speech pre- and post-therapy were measured similarly.

For all tests, we separately analyzed all patients with available pre- and post-teletherapy data as well as the subpopulation of patients who completed ≥4 teletherapy sessions and/or who were deemed appropriate for discharge from teletherapy program due to meeting predefined therapeutic voice goals. SPSS software (IBM, Chicago, IL) was used for statistical testing. GraphPad software was used for graphical representation of data.

RESULTS

Patient characteristics

In total, 234 patients met our inclusion criteria (Table 1). They resided throughout the state of Michigan (39 of 83 counties represented) with their homes a mean (SD) distance of 51.3 (67.1) miles from the University of Michigan in Ann Arbor, MI (Figure 1). Patients were commonly diagnosed with multifactorial dysphonia prior to initiating therapy (Table 1). Of included patients, 18 (7.7%) had procedure(s) before or during their teletherapy course. These included direct laryngoscopy with CO_2 laser excision of benign or malignant vocal fold lesions (n = 8), injection laryngoplasty (n = 6), Type 1 thyroplasty (n = 2), and botulinum toxin injections of the thyroarytenoid muscles (n = 2). Due to the multidisciplinary nature of our clinic, some of our patients (n = 94, 40.1%) had an initial in-person evaluation with SLP concurrently with assessment by one of our laryngologists. The remainder (n = 140, 59.9%) had solely remote SLP care.

TABLE 1.
Characteristics of Patient Cohort

	Cohort (n = 234)
Sex	
Male	71 (30.3)
Female	163 (69.7)
Race/ethnicity	
Caucasian	194 (82.9)
Black/African American	24 (10.3)
Asian/Pacific Islander	8 (3.4)
Other/unknown	8 (3.4)
Age, y	51.6 (19.5)
< 18	18 (7.7)
≥ 18	216 (92.3)
No. of distinct diagnoses	
Single	136 (58.1)
Two	89 (38.0)
Three	6 (2.6)
Four	3 (1.3)
Specific diagnosis	
Muscle tension dysphonia	145 (62.0)
Benign vocal fold mucosal lesion(s)	55 (23.5)
Vocal fold motion impairment	46 (19.7)
Laryngopharyngitis	33 (14.1)
Hyperfunctional neurologic disorders *	23 (9.8)
Presbyphonia	22 (9.4)
Acute laryngeal injury	5 (2.1)
Functional dysphonia	5 (2.1)
Hypofunctional neurologic disorders †	4 (1.7)
Laryngotracheal stenosis	3 (1.3)
Malignant vocal fold mucosal lesion(s)	3 (1.3)

* Includes spasmodic dysphonia and vocal tremor.
† Includes ALS and Parkinson's disease.
Diagnosis percentages exceed 100% due to presence of multiple diagnoses in some patients. Data presented as n (%) or mean (SD).

Adherence to teletherapy program

The mean (SD) number of teletherapy sessions attended per patient was 4.2 (3.0) (Figure 2). Teletherapy was delivered over a mean (SD) time interval of 98 (91) days in patients who attended more than one session. Adherence to teletherapy was high. The majority (n = 159, 68.0%) of patients completed four or more sessions and/or were deemed appropriate for discharge from the teletherapy program due to meeting predefined therapeutic goals. Similarly, teletherapy attendance was high. Of 976 total teletherapy sessions, the documented patient "no-show" or cancellation rate within 24 hours of their scheduled session was only 1.8% (18 sessions).

Self-report and clinician-rated assessments of voice quality

The V-RQOL score was documented in 161 (68.8%) patients prior to teletherapy start. Their mean (SD) calculated total score on the V-RQOL was 62.9 (25.0). In 48 (20.5%) patients, V-RQOL score was also documented after last teletherapy session. There was a significant positive increase in calculated total score on the V-RQOL in these patients as well as in the subset of patients (n = 43) who completed four or more sessions and/or were deemed appropriate for teletherapy discharge. These data specifically are presented in Table 2.

The GRBAS score was documented in 135 (57.7%) patients prior to teletherapy start. Their mean (SD) GRBAS grade was 1.7 (0.6). A minority (n = 83, 35.5%) of included patients had both V-RQOL and GRBAS score documented prior to teletherapy start. In 61 (26.1%) patients, GRBAS grade was also documented after last teletherapy session, with a mean (SD) GRBAS grade 1.2 (0.6). There was a significant improvement in GRBAS grade in these patients as well as in the subset of patients (n = 53) who completed four or more sessions and/or were deemed appropriate for

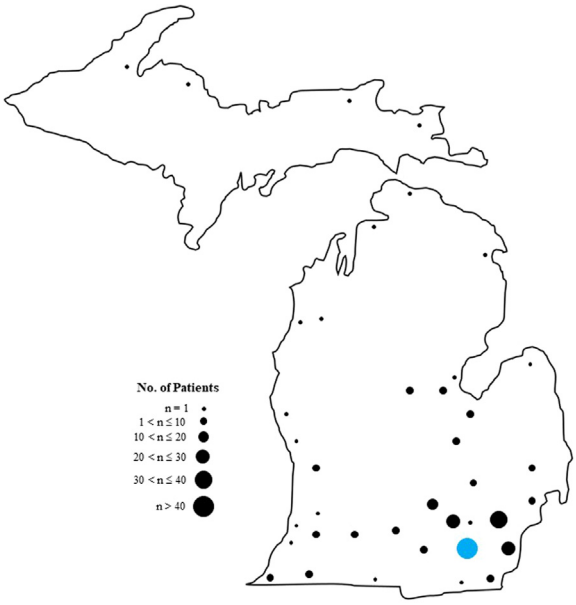

FIGURE 1. Michigan state map depicting residences of patients included in our cohort. Blue dot represents Ann Arbor, MI. For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.

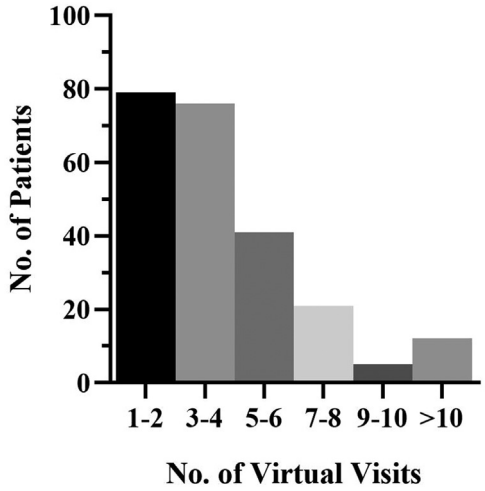

FIGURE 2. Histogram of teletherapy sessions attended per patient.

teletherapy discharge. These data specifically are presented in Table 2.

Aerodynamic measurements

Measurements of MPT and S/Z ratio pre- and post-teletherapy reflected a heterogeneous patient population. MPT was documented in 204 (87.2%) patients prior to teletherapy start. Their mean (SD) MPT was 13.2 (6.9). In 34 (14.5%) patients, MPT was also documented after last teletherapy session. In this subset, no change in MPT was seen (pre- and post-teletherapy mean [SD] score 12.0 [6.4] and 13.2 [5.1], respectively, diff + 1.3 [95% CI: −0.5 to 3.0], $P = 0.2$). S/Z ratio was documented in 137 (58.6%) patients prior to teletherapy start. Their mean (SD) S/Z ratio was 1.3 (0.9). In only seven patients, S/Z ratio was also documented after last teletherapy session. While there was a significant decrease in S/Z ratio seen (pre- and post-teletherapy mean [SD] S/Z ratio 1.3 [0.4] and 0.8 [0.2], respectively, diff −0.5 [95% CI: −0.9 to (−0.1)], $P = 0.03$), this is likely not a clinically meaningful change as they are within normal ranges.

Teletherapy outcomes

Among patients with adequate documentation who completed more than one teletherapy session (n = 177, 75.6%), complexity of vocal tasks presented increased in 78.0% (138 of 177) of patients by last session (Figure 3). Ninety of 138 patients (65.2%) had progressed to conversational voice tasks at last teletherapy session ($P < 0.01$ for pre- and post-teletherapy comparison). These percentages were very similar in the subset of patients who completed four or more sessions and/or were deemed appropriate for teletherapy discharge (82.0% and 54.9%, respectively). Finally, carryover of target voice for isolated tasks and connected speech additionally showed significant improvement in our population (Figure 4).

DISCUSSION

Onset of the COVID-19 pandemic in early 2020 presented numerous substantial barriers to routine, in-person laryngologic and SLP care. Mitigation of infectious risk to patients and healthcare personnel and prudent use of personal

TABLE 2.
Self-Report and Clinician-Rated Assessments of Voice Quality Pre- and Post-Teletherapy

	Preteletherapy	Post-Teletherapy	Change	*P*-Value
V-RQOL, calculated total score				
All patients (n = 48)	58.6 (25.5)	68.2 (23.7)	+ 9.7 (95% CI: 2.8 to 16.4)	< 0.01
D/c and/or four sessions (n = 43)	60.1 (25.2)	67.3 (24.3)	+7.2 (95% CI: -0.2 to 14.6)	0.055
GRBAS, grade				
All patients (n = 61)	1.7 (0.6)	1.2 (0.6)	−0.6 (95% CI: -0.8 to (−0.4))	< 0.001
D/c and/or four sessions (n = 53)	1.7 (0.6)	1.0 (0.5)	−0.6 (95% CI: -0.8 to (−0.5))	< 0.001

Paired samples *t* test used with $P \leq 0.05$ considered statistically significant. Data presented as mean (SD).

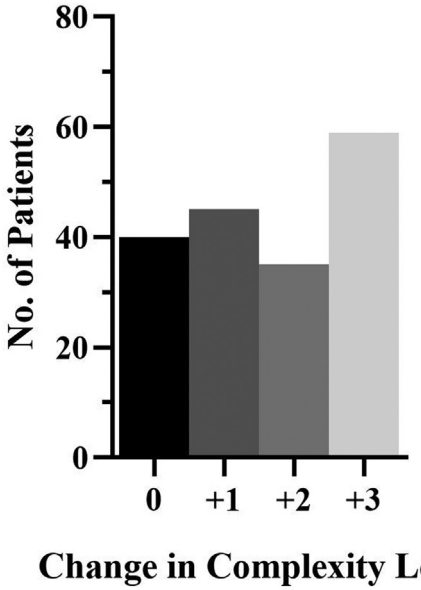

FIGURE 3. Histogram of change in vocal task complexity level with teletherapy among all patients who completed more than one teletherapy session (n = 177). Vocal task complexity categorized from least to most complex as 1: isolated/sustained sounds; 2: syllables; 3: words/structured phrases; 4: conversational speech. X-axis denotes stable (0) complexity level or increase in complexity level by one (+1), two (+2), or three (+3) levels with teletherapy.

protective equipment were of paramount importance.[12,13] Teletherapy offered an attractive potential solution to such concerns. Recognizing this, the Centers for Medicare and Medicaid Services and private insurances companies (Cigna, Bloomfield, Connecticut, USA, United Healthcare, Minnetonka, Minnesota, USA) expanded reimbursement for teletherapy services.[22,23] Many institutions, including our own, saw a tremendous surge in teletherapy visits for patients with dysphonia, dysphagia, chronic cough, and globus.[8,9] Now more than two years into the pandemic, how medicine is practiced in the United States has profoundly changed, with growing patient expectation of, and satisfaction with, virtual platforms for care.[24] The United States Department of Health & Human Services' Public Health Emergency declaration has permitted flexible reimbursement for teletherapy services during the COVID-19 pandemic.[25] While Health & Human Services' anticipates continuation of this declaration into the latter half of 2023, whether broad payer reimbursement for teletherapy will continue after this declaration expires is unknown. Thus, "real-world" studies such as ours may prove valuable in justifying continued payer reimbursement in the future.

Published studies on teletherapy specifically for patients with dysphonia are small, heterogeneous and limited to the prepandemic era. Thus, a critical appraisal of the use and effectiveness of teletherapy for patients with dysphonia in large, single-institution cohort is important to justify continued use, define optimal patient populations and metrics for success, and support indefinite reimbursement. Our study addresses this crucial need.

A major barrier to success of in-person voice therapy for patients with dysphonia is treatment dropout. In an important study by Portone et al,[26] 38% of patients did not follow through with the otolaryngologist's recommendation for voice therapy. Of those who did, 47% did not return after initial SLP evaluation. Intuitive predictors of dropout after initial evaluation, including age, sex, diagnosis, insurance status, and quality-of-life impairment are poorly correlated with therapy completion.[25] However, distance to the clinic does reliably predict therapy continuation and completion, suggesting that ease of access is of utmost importance to patients.[27,28] Patients in our study lived throughout the state

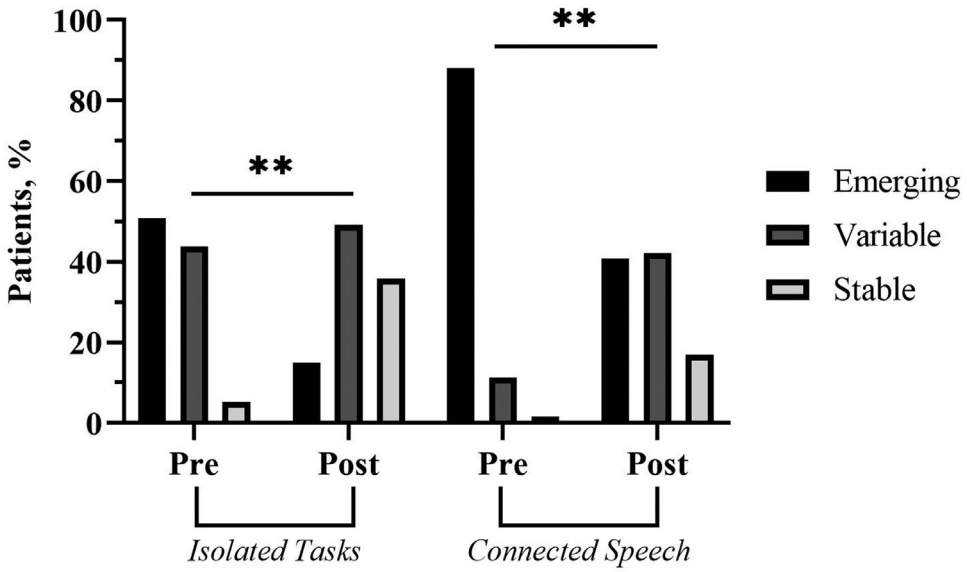

FIGURE 4. Carry-over of target voice for isolated tasks and connected speech. Pre- and post-teletherapy comparisons made using chi-square test, $\alpha = 0.05$. ** $P < 0.01$.

of Michigan, including as far as the Upper Peninsula over 500 miles from our clinic (Figure 1). In our study, we did not include patients who elected to not pursue speech therapy after laryngologists' recommendation to do so. However, we can compare our rate of therapy drop-out after initial speech therapy session with that of Portone et al. In contrast to Portone et al,[26] 87% of our patients attended more than one teletherapy session (Figure 2). Further, the "no-show" and cancellation rate was quite low, at less than 2% of all scheduled sessions. This is considerably lower than the approximately 19% "no-show" and cancellation rate our center averages for in-person visits across all diagnoses. By eliminating transportation costs, travel time, and lost work/productivity hours, our teletherapy program maximized patient access, convenience, and practicality. However, as the pandemic drastically reduced many of our patients' routine occupational demands and social interactions, the true impact of our teletherapy program needs continued validation for patients living with more typical, day-to-day obligations.

Our clinicians typically targeted a minimum of four teletherapy sessions to maximize carry-over of target voice into everyday conversational tasks. This benchmark is based on several studies showing enhanced success and durability of treatment in patients with dysphonia completing at least four therapy sessions.[27,29] The majority of our patients (68.0%) completed four or more sessions and/or were deemed appropriate for discharge from their teletherapy program due to meeting predefined therapeutic goals. The average "completion rate" of speech therapy programs for patients with dysphonia in the published literature is approximately 30-40 %.[26-28] However, this is an imprecise estimate owing to heterogeneous patient populations, retrospective, uncontrolled study designs, and operative definitions for "therapy completion." Nevertheless, we show impressive adherence and longevity, we recognize that future studies are needed to validate the four-session benchmark and better define optimal between-session intervals specifically for teletherapy in patients with dysphonia. Clinician expertise and personalization of therapeutic goals to individual patients' needs is of course paramount.

No consensus exists regarding the most reliable, reproducible, and clinically meaningful outcome(s) for gauging teletherapy success in patients with dysphonia. Many studies have focused on only a single or select few outcomes, including PROMs (eg, V-RQOL, VHI),[13] auditory perceptual assessments (eg, GRBAS),[9] stroboscopic findings,[8] or patient satisfaction.[29,30] In our cohort, patients experienced an almost ten-point increase in V-RQOL score post-teletherapy. While not quite equivalent to V-RQOL scores in normal individuals, this represents a statistically significant improvement in subjective voice quality overall.[31] Similarly, GRBAS grade significantly improved post-teletherapy, showing concordance of self-report measures with clinician rating of voice quality in our patients. The relative stability in MPT and S/Z ratio pre- and post-teletherapy may reflect that these outcomes are arguably less informative in a heterogeneous group of cases of dysphonia where the mean pretreatment MPT and S/Z ratios fell near normal limits and where it is unclear whether increased phonation duration would be meaningful for all the cases. It may also be attributable to the modest sample size in our study.

Few studies have reported other important outcomes of therapy success in dysphonic patients, including progression of complexity of vocal tasks across treatment and carry-over of target voice for isolated, therapy-based tasks versus connected/conversational speech. Our study is unique in this regard. While many voice clinicians use similar metrics to develop and monitor individualized therapeutic goals, guide at-home exercises, and determine teletherapy duration and treatment success, these relevant data points are seldom reported in outcomes literature.[32] This marks a missed opportunity to gauge patient response to interventions across treatment. Importantly, we saw statistically significant improvement in all metrics in our cohort, supporting the conclusion that teletherapy is comparable to in-person formats in its versatility, adaptability, and sophistication. To better define objective standards for success, we posit that these outcomes are crucial to assess and report in future publications on teletherapy in dysphonic patients.

Our study is limited by its retrospective, uncontrolled, single-institution design. The "real-world" nature of our study led to inconsistent data collection for certain metrics (eg, V-RQOL, MPT), limiting the strength of our conclusions. Prospective, multi-institutional, controlled studies confirming efficacy of teletherapy for patients with dysphonia are needed, though are fraught with challenges, especially in the pandemic era.[33] Future studies may additionally consider examining impact of specific demographic (eg, patient age, sex) and clinical (eg, diagnosis) factors on teletherapy outcomes. We were not powered to do so in our retrospective study. As noted above, some of our patients (n = 94, 40.1%) had an initial in-person evaluation with SLP concurrently with assessment by one of our laryngologists. The remainder (n = 140, 59.9%) had solely remote SLP care, though all patients did have laryngoscopy or laryngeal stroboscopy performed prior to therapy start. Lack of stroboscopic examination is often cited as one of the principal disadvantages of a solely remote format for voice therapy.[33] In applicable patients, initial in-person visit was limited to patient history, voice assessment and description of therapeutic program and goals. Thus, we do not feel this confounds our study's conclusions on teletherapy for dysphonic patients. Our study suggests that initial visits can be conducted in either in-person or virtual format, dependent on patient and clinician preference. Finally, our clinicians did not adhere to an identical teletherapy program for all patients and outcome categorization was heterogeneous, thus there is potential for bias. While recognizing this as a limitation, we do feel it replicates real-world practices in typical academic vocal health centers. Finally, we did not collect more granular data on technical or logistical challenges experienced by our patients during their teletherapy course.

Moving forward, we note that teletherapy success, like traditional in-person therapy formats for patients with

dysphonia, is dependent on a number of individual factors that can include diagnosis, patient motivation, and clinician match or expertise.[34,35] We foresee rapid growth in the teletherapy format for patients with various voice, swallowing and breathing concerns in the coming years. While truly exciting, we simultaneously echo the importance of thoughtful patient selection, adequate technological capability and support, and reproducible outcome measures.

CONCLUSIONS

In our large, single-institution study, we showed teletherapy to be a versatile and efficacious approach for treatment of patients with dysphonia of varying age, geography, and diagnoses. In the pandemic era, our study supports the routine use of this format in centers with appropriate personnel and resources. Further studies, ideally prospective and controlled, are needed to further this exciting and proliferating field.

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