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Implementation and early experience of a pediatric electrophysiology telehealth program

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BACKGROUND Telehealth (TH) visits have been growing with exponential increased utilization during the COVID-19 pandemic. The aim of this manuscript is to describe the implementation and early experience of a pediatric electrophysiology (EP) TH program implemented during the pandemic, assessing patient satisfaction, patient equity and inclusion (measured by geographical outreach), and sustainability.

METHODS A retrospective chart review study was performed and data were collected from the medical record, including demographic, testing, and billing data from scheduled TH encounters between March and August 2020 of a single pediatric EP group in the Midwest. Patients were called to complete satisfaction surveys.

RESULTS Patients with diverse pathologies were seen in TH, with supraventricular/atrial tachycardias (n = 41, 35%) and inherited arrhythmia syndromes (n = 23, 20%) being most common. The mean distance from clinic was 95 miles (range 2.8–320 miles), with 43% of patients living more than 100 miles away from clinic. A total of 172 tests were performed previsit (n = 102, 59%), during the visit (n = 17, 10%), or postvisit (n = 53, 31%), including 15 EP studies. Time-based Current Procedural Terminology codes were predominantly used for billing purposes (n = 92, 78%). There was generation of work relative value units (wRVU) for visits (220.5 wRVU) and testing (325.1 wRVU). Survey data demonstrated that 98% of patients were satisfied with their telehealth appointment and 99% had a clear understanding of their diagnosis.

CONCLUSION Pediatric EP TH clinics can provide care for a geographically and pathologically heterogeneous group of patients who had positive attitudes toward TH. Our study shows significant downstream testing and subsequent wRVU generation, suggesting financial sustainability.

KEYWORDS Digital Health; Electrophysiology; Financial sustainability; Geographic diversity; Pediatrics; Telehealth

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Introduction

Telehealth (TH) programs have been gaining momentum over the past several decades and are characterized as a technological bridge to transfer and deliver patient health information.[1] Teleconsultation, which encompasses synchronous patient-to-provider interactions, has historically been a small yet integral part of the global healthcare ecosystem.[2] Importantly in the pediatric realm, there are multiple benefits to using TH, including improving access to specialty care to remote communities, lessening the burden of absences from work or school, and optimizing patient/family medical engagement.[3] Various modalities of TH have been described in pediatric cardiology and are well summarized in the American Heart Association statement.[4] Over the last 20 years, with advancements in cardiac-related technologies and positive patient attitudes toward TH,[2] there has been an interest and expansion in pediatric cardiology TH programs. In addition, the recent COVID-19 pandemic has driven many departments to expand their TH programs to decrease COVID-19 transmission. Interestingly, there have been no studies assessing a TH program in pediatric electrophysiology (EP), which centers around the diagnosis and management of heart rhythm abnormalities. This subspecialty would preferentially benefit from TH owing to its well-established remote monitoring technologies and engagement with digital health technologies.[5]

This single-center retrospective study aims to elucidate the fundamentals and sustainability of a pediatric EP TH program, focusing on patient satisfaction, geographical outreach, and financial viability during the COVID-19 pandemic. The secondary objectives were to assess the common diagnoses and testing performed surrounding a pediatric EP TH clinic.

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KEY FINDINGS

- Telehealth (TH) encounters provide a feasible option for pediatric electrophysiology (EP) patients.
- A wide spectrum of diagnoses is amenable to be seen in pediatric EP TH clinics, including supraventricular tachycardias, inherited arrhythmia syndromes, ventricular tachycardia/premature ventricular complexes, syncope, and palpitations.
- Overwhelmingly, patients/families felt confident in understanding their cardiac issues, had a clear plan in place following their TH visit, and were overall satisfied with their TH appointment.
- Pediatric EP TH clinics can capture patients from a diverse geography (range of 2.8–230 miles) from our institution, and with 43% of patients living >100 miles from our campus.
- Adjunctive testing for TH visits, including previsit, during-visit, and postvisit testing, can help maximize the utility of TH visits with testing performed at locations close to patient/family location.
- In the future, digital health technologies (both direct-to-consumer and prescription devices) may be able to expand the reach for TH programs.

Methods

After approval was obtained from the Institutional Review Board with adherence to the Helsinki Declaration as revised in 2013, a retrospective chart review was performed to identify patients who had a pediatric EP TH visit between March and August 2020. All visits were conducted with real-time video-audio using the Washington University HIPAA-compliant Zoom (Zoom, Inc, San Jose, CA) platform. Data extracted from these encounters encompassed patient demographic data, type of visit, diagnosis, previsit testing (defined as any testing ordered and performed within 30 days prior to the visit), during-visit testing, postvisit testing (defined as any testing ordered because of the encounter), patient's zip codes, and billed Current Procedural Terminology (CPT) codes. Remote transmission data from pacemakers (PMs), intracardiac defibrillators (ICDs), or insertable cardiac monitors (ICMs) were used during the TH visit, and were either routine transmissions, patient-initiated symptoms transmissions, or unique transmissions requested by the care team if there was not a recent check documented in the patient chart. For those patients who required testing pre or post visit, local testing sites within our healthcare system were offered; for those patients who were remote (>30 miles) from a facility within our system, the nearest system willing to perform pediatric testing was identified and information provided to families. Inclusion criteria for this study included any patient scheduled for a pediatric EP TH visit from March 2020 to August 2020 and age 0–21 years. Exclusion criteria included non-English-speaking patients and wards of the state. Though our providers all maintain medical licenses in both Missouri and Illinois, allowing for TH visits for patients in both states during the COVID-19 pandemic, both our institution and payors allowed for across-state-border TH visits.

A phone survey designed to assess patient's and family's experience during the TH visit was developed. Patients were contacted by the research team and prospectively consented for participation, with measures taken to ensure anonymity and avoid coercion. Both consent and questionnaire scripts were used to reduce variability in survey delivery between investigators. The questionnaire consisted of multiple statements pertaining to their pediatric EP TH visit. The respondents scored each statement using a Likert scale from 1 to 5 (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Survey questions were designed to measure patient satisfaction of the TH visit, perceived costs, use of digital health technology, freedom from missing work/school, perceived understanding of diagnosis, travel distance saved, and future preferences related to pediatric EP TH visits. The responses were recorded by the surveyor using a secure electronic spreadsheet and tallied for statistical analysis.

CPT codes were extrapolated from the electronic medical record for each visit and testing performed, from which we were able to generate total work relative value units (wRVU).

Statistical analysis

Quantitative analysis with frequencies and percentages were used to analyze patient demographics, diagnoses, and phone survey responses.

Results

Demographic data

There were a total of 121 patients scheduled for pediatric EP TH appointments between March 2020 and August 2020 with a 98% participation rate in TH visits. A total of 3 patients (2%) were not included in further analysis owing to either patient cancellation prior to the appointment or patient "no-show" at time of appointment. For the 118 patients included in the analysis, 56% (n = 66) were female, 64% (n = 76) were over the age of 10, 21% were aged 6–9 years, and 15% were aged 0–5 years. Most TH appointments were with established patients (69%), with the rest new patient visits (Table 1).

The most common diagnoses for TH visits were supraventricular tachycardia or atrial tachycardia (n = 41, 35%) and inherited arrhythmia syndromes (n = 23, 20%). Other encountered diagnoses were premature ventricular contractions or ventricular tachycardia (n = 13, 11%), syncope/near-syncope (n = 13, 11%), follow-up cardiac implanted electronic device (CIED)/device checks (n = 6, 5%), cardiomyopathy/myocarditis (n = 4, 3%), palpitations (n = 4, 3%), complete heart block (n = 2, 2%), and other (n = 12, 10%).

Table 1 Demographic data

	Patients, n (%)
Sex	
Female	66 (56%)
Male	52 (44%)
Age group	
0–5 years	17 (15%)
6–9 years	25 (21%)
≥10 years	76 (64%)
Appointment type	
Arrived	118 (98%)
No-show	3 (2%)
Visit type	
New patient	39 (33%)
Established patient	79 (67%)
Diagnoses	
Supraventricular tachycardia/atrial tachycardia	41 (35%)
Inherited arrhythmia syndromes	23 (20%)
Ventricular tachycardia/premature ventricular contractions	13 (11%)
Syncope/near-syncope	13 (11%)
Device check	6 (5%)
Cardiomyopathy/myocarditis	4 (3%)
Palpitations	4 (3%)
Complete heart block	2 (2%)
Other	12 (10%)

To understand if this pediatric EP TH program was able to address healthcare access disparities to a pediatric EP physician, the geographic distribution of our patient population was calculated based on patient/family zip codes. The mean distance (evaluated by driving distance) from patient to St. Louis Children's Hospital/Pediatric EP Clinic was 95 miles (range 2.8–320 miles). Only 16% of patients lived within a 20-mile distance from our clinic, with most patients located 20–100 miles away (n = 48, 41%) or between 100 and 200 miles away (n = 33, 28%); 15% of patients (n = 18) lived >200 miles from our clinic.

Testing and sustainability

A total of 172 tests were performed either previsit, during the visit, or postvisit (Table 2). Most tests, 59% (n = 102), were performed previsit, including 42 12-lead electrocardiograms (ECGs) (41%), 17 Holter monitors (17%), 3 event monitors (3%), 17 echocardiograms (16%), 4 exercise stress tests (4%), 2 electrophysiology studies (2%), 7 remote device transmissions (7%), and 10 photos of procedural wounds (10%). Previsit testing was often performed at a local hospital with information transmitted electronically. There were 17 tests (10%) completed during the TH visit, including 4 single-lead ECGs (24%) using a direct-to-consumer ECG device (either Kardia Monitor by AliveCor or Apple Watch by Apple), 7 wound check photographs (41%), and 6 CIED remote device transmissions (35%). A total of 53 postvisit tests (31%) were performed, including 5 12-lead ECGs (9%), 1 single-lead ECG (2%), 13 Holter monitors (25%), 6 event monitors (11%), 4 echocardiograms (8%), 3 exercise stress tests (6%), 15 EP studies (28%), 5 remote CIED device transmissions (10%), and 1 wound check photograph (2%). The total number of wRVUs generated from this testing was 325.1 RVUs (Table 2).

A total of 17 different CPT codes were billed during these TH visits. CPT code assignments occur though an independent billing and coding group within the institution. The 3 most common CPT codes were time-based established patient codes, including 99214 (55 visits, 45%), 99213 (23 visits, 19%), and 99215 (9 visits, 7%). There were a limited number of new consult-based CPT codes used (14 visits, 12%). For each CPT code, there is a given wRVU conversion factor. Using this conversion factor, the total number of generated wRVUs from billed CPT codes was 220.47 (Table 3).

Survey results

A total of 72% of patients (85/118) who had a TH visit participated in the prospective phone surveys (Figure 1). More than 98% of participants agreed/strongly agreed that they were confident in understanding their cardiac issues, had a clear plan in place, and were overall satisfied with their TH appointment, and 92% reported that they would recommend TH to their friends and family. Additionally, 81% of participants agreed/strongly agreed that they missed less time from work and/or school compared to regular in-office clinic visits. Although 80% of respondents said they would choose TH appointments in the future, only 44% indicated a preference for a pediatric

Table 2 Testing and downstream work relative value units generated

Test	No. of tests previsit	No. of tests during visit	No. of tests postvisit	Total	wRVU/CPT code	wRVU generated
12-lead ECG	42	0	5	47	0.17	7.99
Single-lead ECG	0	4	1	5	0.15	0.75
Holter monitor	17	0	13	30	0.39	11.7
Event monitor	3	0	6	9	0.52	4.68
Echocardiogram	17	0	4	21	1.46	30.66
Exercise stress test	4	0	3	7	0.75	5.25
Invasive EP study	2	0	15	17	14.75	250.75
Device transmission	7	6	5	18	0.74	13.32
Wound check/photo of operation site	10	7	1	18	0	0
Total	102	17	53	172		325.1

CPT = Current Procedural Terminology; ECG = electrocardiogram; EP = electrophysiology; wRVU = work relative value units.

Table 3 Frequency of current procedural terminology codes used for telehealth visits

Billed CPT code	Code description	No. of visits	wRVU conversion	Total wRVU / CPT code
99214	Time based, established patient, ~25 min	55	1.92	105.6
99213	Time based, established patient, ~15 min	23	1.3	29.9
99215	Time based, established patient, ~40 min	9	2.8	25.2
99243	New or established consultation code, ~40 min	7	1.88	13.16
99203	New patient, ~30 min	6	1.6	9.6
99244	New or established consultation code, ~60 min	3	3.02	9.06
99443	Telephone visit, >20 min	3	1.92	5.76
99204	New patient, ~45 min	2	2.6	5.2
99442	Telephone visit, ~10 min	2	1.3	2.6
99243	New or established consultation code, ~30 min	1	1.88	1.88
99354	Prolonged physician service, >60 min	1	2.33	2.33
99254	New or established consultation code, mid-high complexity	1	3.77	3.77
99241	New or established consultation code, 15 min	1	0.64	0.64
99205	New patient, ~60 min	1	3.5	3.5
99242	New or established patient, ~30 min	1	1.34	1.34
99024	Postoperative follow-up visit	1	0	0
99202	New patient, ~20 min	1	0.93	0.93
Total		118	-	220.47

CPT = Current Procedural Terminology; wRVU = work relative value units.

EP TH visit instead of an in-office EP visit. Roughly one-third (32%) of participants noted that out-of-pocket costs were less with TH than in-person appointments, while 49% reported there was no difference. Most participants, 95%, did not have any connectivity issues during their TH appointment. In subgroup analysis of surveys from new patients with first visit as TH (n = 30), 97% (29/30) reported they agreed/strongly agreed that they were confident in the understanding of their cardiac issue and had a clear plan in place, with 100% (30/30) reporting that they were satisfied with their TH visit.

Discussion

To our knowledge, this is the first pediatric EP TH study focusing on patient satisfaction and financial sustainability. With continued technological advancements and an outpatient healthcare shift toward TH during the COVID-19 pandemic, our study comes at a critical point in time assessing the viability of TH programs in pediatric cardiology subspecialties. Synchronous TH, specifically teleconsultation in pediatric cardiology, is a small aspect of TH, with limited studies.[6–17] Previous studies assessing this type of pediatric TH program have shown multiple benefits, including

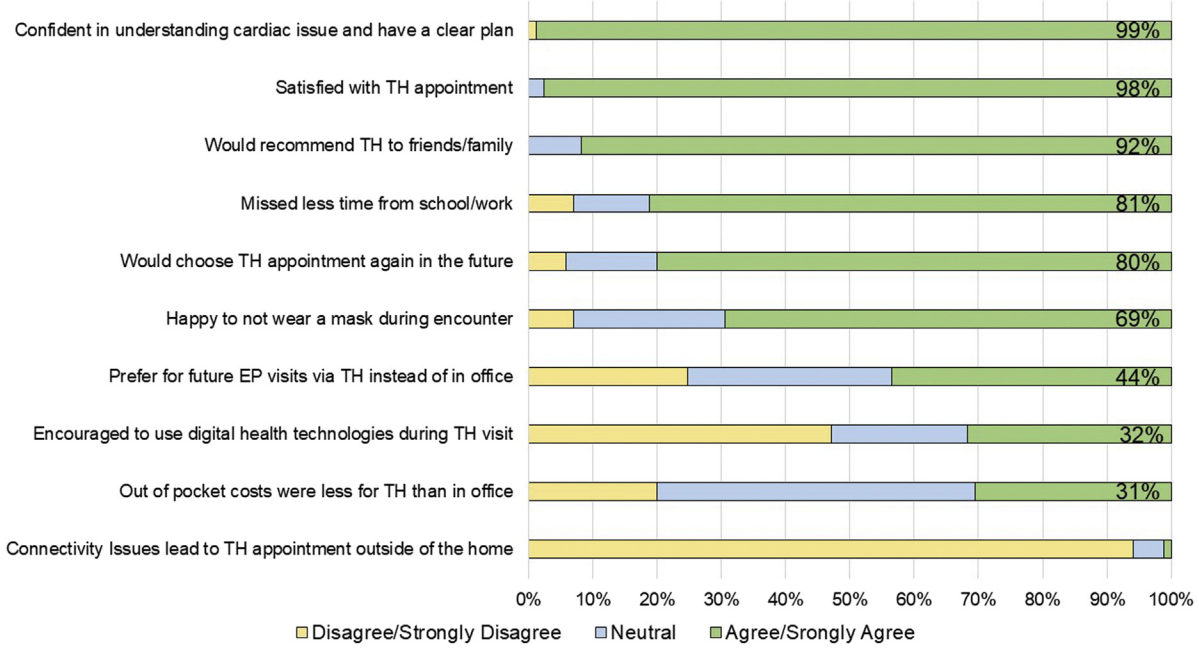

Figure 1 Survey results. The green bars represent the percentage of respondents who either agreed or strongly agreed with the statements along the y-axis, with data labels in the green bar. The yellow bars represent percentage of respondents who disagree or strongly disagree, and the blue bar represents the percentage of respondents who provided a neutral response to the statement.

improved patient outreach, cost benefits, and positive patient attitudes toward telecommunication.[6,14,18]

Prior pediatric TH studies have shown patient positive attitudes toward communication over videoconferencing or telephone encounters as well.[6–9] The survey results in this study clearly show that our patient population had high levels of satisfaction about their appointment and understanding of their diagnosis. Interestingly, while many patients would consider a TH appointment in the future, nearly half of our patients provided a neutral response when asked if in-office vs TH visits were preferred, implying that TH will not substitute in-office visits, but rather are a tool that can be used as part of ongoing care for patients. Patients with complex congenital heart disease or those who had an established EP provider preferred the option of in-person appointments, even during the COVID-19 pandemic. This may be secondary to a lack of cultural acceptance for a physician visit without a traditional physical examination or real-time diagnostic testing. A consideration for an optional multisetting (in-office and TH) clinic approach may bridge this gap between patient's preferences and provide more personalized/patient-centered care when referring or creating appointments. Additionally, providing a map of centers for pre- or postvisit testing may be beneficial in optimizing patient accessibility to obtain testing.

Future studies may further investigate the use of digital health technologies to enhance the physical exam during TH visits and improvement in patient satisfaction. Technologies such as the KardiaMobile Monitor and the Apple Watch series 6 have previously been used in our practice to transmit useful data from patient to provider, assisting in diagnosis and management of arrhythmias. While only a small percentage of our patient population for this study was asked to use these technologies, successful workflows have been developed for patients to communicate this information with their provider.[19] This can potentially lead to decreased anxiety over diagnosis, increased communication with provider teams, and confidence in management plan and understanding of patient diagnosis.

Our TH patient population primarily resides outside of the urban St. Louis area. In fact, the geographical dispersion in our patients was far reaching, where the average distance from our clinic was 95 miles and 43% of our patients lived >100 miles away. A similar pediatric cardiology telemedicine study by Phillips and colleagues[14] found that their 26 patients lived a mean distance of 35 miles away. Given this finding, it is not surprising that many of our patients reported missing less time from work or school-related activities compared with standard clinic visits.

Previsit and postvisit testing conducted at hospitals or testing facilities closer to our patients required a modified workflow from our team to ensure testing had been ordered, testing completed, and records entered into the electronic medical record. Our workflow included (1) notification of nursing team as to what testing was required on a given patient; (2) nursing team identifying a local facility able and willing to perform testing; (3) nursing team communicating with patient and family about where to go for testing; (4) tests results being sent back to our facility, entered into the electronic medical record system, and routed to the ordering physician; and 5) physician communicating back to patient and family with test results. This workflow requires a nimble team dynamic. At the current time, additional team members have not been required to help usher through these patients, though having at least a partial or dedicated team member to aid in this follow-up is an important consideration when considering the startup costs for a TH clinic.

Prior to the pandemic, reimbursement was highly restricted by Medicare and many private insurers owing to specific rules regarding types of communication, patient location, and licensure of physicians. This narrowed the patient demographic selection and added financial concerns to departments/divisions about the viability of such programs. With the onset of the COVID-19 pandemic, TH was used to provide health care with fewer financial constraints from insurance companies and allowed for healthcare revenue for hospitals. Under the COVID-19 emergency declaration act, Medicare is able to reimburse for TH services at the same rate as regular, in-person visits.[20] Although pediatric patients use Medicaid for those with federal health insurance, a comprehensive list of acceptable-use CPT codes were added to the Centers for Medicare and Medicaid Services formulary,[21] which expanded reimbursement opportunities.

In addition, provider state licensure status is critical in broadening the outreach of a TH program and can incur additional costs and time commitment for acquiring and maintaining multiple medical licenses. Given our geographic location, our program requires 2 state licenses for all providers. With the growth of our TH program, our licensing requirements have grown as well to include additional states to the west, north, and south of our geography. These regulatory considerations must be considered both at time of inception of a TH program and during growth.

Our study primarily used time-based, new consultation, and/or postoperative encounter CPT codes. Of those 3 categories, the majority fell in the category of time-based, lending to the amount of robust counseling needed for pediatric EP patients. The wRVUs created from these encounters and the downstream testing performed contributed to the total generated revenue for the cardiology division, providing a sustainable financial option for pediatric EP TH programs moving forward. It remains unclear at this time whether the same reimbursements rates will remain in place. Although there is state-to-state coverage variability, TH reimbursement rates have become more widely accepted by state/local legislators owing to technological advancements and advantages of accessing remote communities. The COVID-19 pandemic has synergistically affected this technological healthcare wave in an unprecedented way, forcing more governments to liberalize TH coverage.

Despite improvement in current reimbursement trends, there remain several disadvantages to TH programs. Telehealth is not immune to clinic challenges, including patient dissatisfaction, family/patient acceptance to TH,

socioeconomic disparities, and concern for continued future reimbursement. Distrust may also exist with patients and their families related to privacy and data confidentiality when using electronic communication.[22] In addition, hesitancy for videoconferencing replacing in-person patient-physician interaction can be an issue for some, as a prepandemic study showed that patients largely preferred face-to-face interactions with their providers.[23] Although a greater proportion of the population now has access to videoconferencing-capable technologies and TH can provide broad outreach, there continue to be socioeconomic disparities among TH patients; namely low median income, higher age bracket, and Medicaid insurance type have been associated with lower rates of TH videoconferencing.[24,25]

Lessons learned

During the development of our pediatric EP TH program, we learned several important lessons. Maintaining communication through secure channels and documentation in the medical record is important given that pediatric EP clinics require a full team effort. Our team has embedded these communications within the EPIC Electronic Medical Record System (Verona, WI) and encourages all patients to enroll in the EPIC MyChart patient portal. TH visit information, including Zoom links, are all maintained within the MyChart portal, allowing patients/families easy access to the TH visit. Additionally, careful screening of patients who are eligible for TH in advance of scheduling patients for this type of visit allowed for a productive TH experience. This prescreening is done by the providers who see patients in these clinics. In our experience, we found that a broad range of pediatric patients were suited for a pediatric EP TH visit. We found that patients/families that had some familiarity with technology and even minimal technology literacy had a more streamlined experience. Additionally, patients who had been seen previously either by a referring pediatric cardiologist or by pediatric electrophysiology and had a significant counseling component to their visit were ideal candidates for TH.

Study limitations

Although there was a reasonable-sized cohort with good response rate to our patient surveys, the sample size was small compared with larger-scale telecommunication programs analyzed within the last decade; Maia and colleagues[16] had >32,000 patients. This was a single-center study, which may not reproduce the same results at other institutions. This institution has a large geographical coverage across the Midwest, and patient population demographics may differ. Our study population all had access to in-home technologies (smartphone, tablet, or computer) with the ability for video conferencing and integrated internet services, which may be a limitation in certain populations. Patient/family self-selection for TH visits may have selected for those with a certain degree of digital literacy, though we were unable to demonstrate racial or geographic disparities in our study population. Also, a detailed physical examination was not able to be performed during telehealth visits, which is a limitation of this methodology. Finally, owing to inconsistent contractual rates and collections for each patient, Revenue Per User values were unable to be calculated.

Conclusion

Rapid development and increasing availability of digital health technologies coupled with the ongoing COVID-19 pandemic have synergistically affected the implementation of TH programs across medical subspecialties, particularly pediatric cardiology. Quantifying RVU generation and the patient experience provides a positive outlook for the future sustainability of pediatric EP TH programs. Based on our study, a pediatric EP TH clinic can harness a wide geographical patient population with diverse pathologies. Notably, pediatric EP has a broader geographical outreach compared to general pediatric cardiology TH clinics. Overall, this study augments a technological healthcare wave pursuing avenues to improve access and quality of care in a more cost-effective manner for the patient while optimizing reimbursement finances. Our experience highlights that TH can improve patient access to quality specialized care.

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Disclosures

The authors have no conflicts of interest relevant to this work.

Authorship

All authors attest they meet the current ICMJE criteria for authorship.

Patient Consent

Patients were contacted by the research team and prospectively consented for participation with measures taken to ensure anonymity and avoid coercion. Both consent and questionnaire scripts were used to reduce variability in survey delivery between investigators.

Ethics Statement

Approval from the Institutional Review Board was obtained. The study adhered to the Helsinki Declaration as revised in 2013.

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