Ambulatory cardiology telemedicine: a large academic pediatric center experience

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ABSTRACT

We performed a retrospective study of cardiology telemedicine visits at a large academic pediatric center between 2016 and 2019 (pre COVID-19). Telemedicine patient visits were matched to data from their previous in-person visits, to evaluate any significant differences in total charge, insurance compensation, patient payment, percent reimbursement and zero reimbursement. Miles were measured between patient's home and the address of previous visit. We found statistically significant differences in mean charges of telemedicine versus in-person visits (2019US$) (172.95 vs 218.27, p=0.0046), patient payment for telemedicine visits versus in-person visits (2019US$) (11.13 vs 62.83, p≤0.001), insurance reimbursement (2019US$) (65.18 vs 110.85, p≤0.001) and insurance reimbursement rate (43% vs 61%, p=0.0029). Rate of zero reimbursement was not different. Mean distance from cardiology clinic was 35 miles. No adverse outcomes were detected. This small retrospective study showed cost reduction and a decrease in travel time for families participating in telemedicine visits. Future work is needed to enhance compensation for telemedicine visits.

INTRODUCTION

The use of telemedicine in pediatrics has been shown to be both cost-effective and time-reducing for clinicians in a variety of pediatric subspecialties including, but not limited to, cardiology, critical care, neurodevelopment, dermatology, patient education, home health, ophthalmology and neonatology.[1–4] In these studies, applications of telemedicine had the greatest effect in servicing populations located far from or without easy access to tertiary or quaternary medical centers and were shown to aid health providers in low-resource centers.[2 5 6]

Within the field of pediatric cardiology, the use of real-time echocardiography has been shown to increase efficiency and accuracy of diagnosis, decrease unnecessary transports of neonates and improve cost-effectiveness in hospitals not served by in-house pediatric cardiologists.[5] Telemedicine has also been used effectively in cardiovascular intensive care units (CICUs) as a feasible option for co-management between CICU intensivists and pediatric ICU intensivists in the care of patients with complex heart disease.[7]

While the use of commercial ambulatory telemedicine visits for general pediatric care has recently increased,[3] ambulatory telemedicine visits for pediatric cardiology have been rare. We describe the use of a novel telemedicine program for outpatient pediatric cardiology visits at a large academic center prior to emergence of the 2019 Coronavirus Disease (COVID-19). Our aims were to (1) assess the feasibility of ambulatory telemedicine visits for pediatric cardiology, (2) evaluate patient's out-of-pocket costs of ambulatory telemedicine visits and (3) assess any major adverse cardiac events after ambulatory telemedicine visits.

MATERIALS AND METHODS

This was a retrospective study of cardiology ambulatory telemedicine visits conducted at a tertiary care children's hospital between April 2016 and July 2019.

Patient selection

At the time of an in-person visit, the cardiologist discussed with the family the option to schedule the follow-up visit as a telemedicine visit. Patients evaluated for hyperlipidemia and patients who underwent cardiac testing other than electrocardiogram (ECG) or echocardiogram were eligible. Patients requiring a consultation with a cardiologist regarding a previous multidisciplinary case-based meeting or outside second opinion were also eligible.

The family/patient and the provider signed remotely into live video, secured telemedicine platform. The provider connected to the meeting from his office, clinic and/or home. Families connected to the telemedicine platform from their home, office and/or school.

Only telemedicine visits of patients who had a previously established in-person visit were included, allowing for data to be compared between similar billing categories (established patients). In cases where patients had multiple telemedicine appointments, the appointment that was selected for comparison was one with the same procedure code as their in-person visit, and if none of the appointments had the same procedure code, then the appointment closest in date to the in-person visit was selected. Data

were obtained from the billing administrative database and electronic medical records (Cerner). Telemedicine visits without previously established in-person visits were excluded.

Miles were measured between patient's home address and the address of the previous in-person visit clinic. A map showing the distribution of patient locations was created using patient zip codes. The median household income was estimated based on patient zip code (https://www.census.gov/quickfacts/fact/table/US). To assess for any potential adverse outcomes, at date of last follow-up, a retrospective review was done on telemedicine and in-person patients to assess if patients had presented urgently to either cardiology clinic or emergency department. Review of adverse outcome follow-up is current as of May 2020.

At Children's National Hospital (CNH), cardiologists see approximately 18,000 annual cardiology visits.[8 9] While our cardiology clinics are spread over a large geographical area, for at least some families there are challenges getting to the clinics due to transportation issues and/or securing time off from work. Thus, ambulatory cardiology telemdinicne visits were established at CNH in April 2016.

Statistical analysis

Telemedicine patient visits were matched to data from their previous in-person visits, to evaluate any significant differences in total charges, insurance compensation, patient payment, percent reimbursement and zero reimbursement. Mean difference in total charges, insurance compensation, insurance reimbursement rate and percent reimbursement between telemedicine appointments and in-person visits were compared using a paired t-test. Mean difference in patient payment was assessed using the non-parametric Wilcoxon signed-rank test. The risk of zero imbursement for a telemedicine appointment compared with an in-person visit was assessed using McNemar's test. All reported figures were adjusted for inflation to the 2019 US dollars (2019US$) by using the Consumer Price Index for medical care (http://data.bls.gov/cgi-bin/dsrv).[10] Data are presented as mean±SD. A p value ≤0.05 was considered to be statistically significant.

RESULTS

Twenty-six patients, 15 (58%) females, had previously established in-person visits and were included in the analysis. The mean age at time of telemedicine visit was 9.9±5 years. Seven patients (27%) were African-American and 16 (62%) were white. The estimated median household income (n=19) was 2019US$95,840 (IQR 90,178–111,758). The most common indications for telemedicine visits were combined hyperlipidemia (eight patients) and pure hypercholesterolemia (five patients) (table 1).

The mean charges of telemedicine appointments were 2019US$172.95±54.46, with insurance reimbursement of 2019US$65.18±50.04 (43%) of total cost. Patients paid 2019US$11.13±16.15 out of pocket for telemedicine visits. Overall, total reimbursement rate for telemedicine visits was 43%. For in-person visits, the mean charges were 2019US$218.27±52.02 with insurance reimbursement of 2019US$110.85±52.79 (61%) of total cost. Patients paid 2019US$62.83±49.26 out of pocket for in-person visits. Overall total reimbursement for in-person visits was 82% (table 2).

Of the 26 telemedicine visits, 13 had the same office visit billing level code for the telemedicine visit and their previous in-person visit. Of those 13 billing codes that differed, 12 of the telemedicine visits were billed for lower level than the in-person visit, one telemedicine visit was billed for higher billing level than the in-person visit. Twenty-two visits were covered by private insurance, two visits were covered by public insurance and two were covered by a grant to use telemedicine to increase access to specialty care for underserved children in the region.

The mean differences between telemedicine and in-person visits were found to be statistically significant and lower for total charges (p=0.0046), insurance compensation (p≤0.001), patient payment (p≤0.001), insurance reimbursement rate (p=0.0029) and overall reimbursement rate (p≤0.001) as shown in table 2. Although not statistically significant, 27% of telemedicine appointments had zero reimbursement compared with only 8% of in-person visits. Average patient distance to CNH cardiology clinic was 35±32) miles. As seen in online supplemental figure 1, patients presented for ambulatory cardiology telemedicine care from Maryland, Virginia and Washington DC.

At a median follow-up of 180 days (IQR 96–248), no patient presented urgently to our health system for a cardiology-related diagnosis after the telemedicine visit. No patient presented urgently after an in-person visit with a median interval between last in-person visit and telemedicine visit of 56 days IQR (29–107). After completion of the telemedicine visit, 12/26 (46%) had a predetermined scheduled in-person cardiology follow-up for their next cardiology visit.

In telemedicine visits rarely have we noted technical difficulties including slow connection times, lack of video connection and dropped video calls. When technical problems occurred, the provider contacted the telemedicine team help line for assistance.

DISCUSSION

In this pre-COVID-19 study, we demonstrated that telemedicine visits are safe and feasible, reduce family burden and are reimbursable. We noted measurable differences in billing charges and insurance reimbursement between telemedicine and in-person cardiology visits.

The difference of charges and insurance reimbursement may be due to several factors. Forty-six per cent of the telemedicine visits were billed at a lower level than their corresponding previous in-person visits. Facility fees were not included in telemedicine visit charges, also leading to overall lower charges. With the recent emergence of telemedicine visits, it is not surprising to see ongoing changes in billing practices, while in-person visit billing is well established and likely to be more consistently billed. Telemedicine visits do not include vital signs and limit performance of a full physical examination, providing billing challenges.[11] In some instances, billing for telemedicine was based on time spent on counseling and coordination of care. How hospitals and clinics bill for telemedicine is likely to continue to evolve

Table 1 Indications for ambulatory cardiology telemedicine visits

#	ICD-10	Reason for the visit	Special comment
1	E78.2	Combined hyperlipidemia.	
2	E78.2	Combined hyperlipidemia.	
3	E78.0	Pure hypercholesterolemia.	
4	E78.2	Combined hyperlipidemia.	Mother and patient joined the conference separately. Mother was in her office and patient was in her school.
5	E78.2	Combined hyperlipidemia.	
6	I47.1	Ectopic atrial tachycardia on beta-blocker. Case was discussed with electrophysiology team. The telemedicine visit was to discuss pros and cons of electrophysiology study/possible ablation versus continuing beta-blocker.	
7	E78.2	Combined hyperlipidemia.	
8	E78.01	Familial heterozygous hypercholesterolemia.	
9	E78.2	Combined hyperlipidemia.	
10	Q22.5	Ebstein anomaly, patent ductus arteriosus, atrial septal defect and chromosomal abnormality (chromosome 1P3 6.3 microdeletion). The telemedicine visit was to review the second opinion from another institution after the cardiologist had a conference call with their senior cardiovascular surgeon.	
11	I49.3	Premature ventricular contraction and attention deficit hyperactivity disorder, on Ritalin. The telemedicine visit was to review the results of a 24-hour Holter monitor.	
12	E78.01	Familial heterozygous hypercholesterolemia.	
13	Q21.0	Conoventricular septal defect status post (s/p) repair. Postoperative course was complicated by junctional ectopic tachycardia treated with procainamide and amiodarone which were later weaned off. The telemedicine visit was to review the results of a 24-hour Holter monitor.	
14	R55	Neurocardiogenic syncope and premature atrial contractions noted on ECG during previous visit. The telemedicine visit was to review syncope symptoms, preventive measures and the results of a 24-hour Holter monitor.	
15	I49.3	Premature ventricular contraction that did not suppress at maximum heart rate. The telemedicine visit was to review the results of a 24-hour Holter monitor.	
16	Q21.0	Down syndrome, perimembranous ventricular septal defect s/p repair with sinus rhythm alternating with junctional rhythm. The telemedicine visit was to review the results of a 24-hour Holter monitor.	
17	E78.2	Combined hyperlipidemia.	
18	E78.01	Familial heterozygous hypercholesterolemia.	
19	Q22.4	Chromosome 8 deletion, tricuspid atresia (type 1C), severely hypoplastic right ventricle, ventricular septal defect, normally related great vessels, small subaortic region, s/p Glenn palliation and most recently s/p repair of subaortic stenosis. The telemedicine visit was to discuss the results of a recent cardiac catheterization, MRI with a plan to move ahead with Fontan.	Family lives 100 miles away. Using non-verbal communication, provider was able to clarify the confusion and reach shared decision with family.
20	E78.2	Combined hyperlipidemia.	
21	I49.3	Premature ventricular contractions with different morphologies. Case was discussed with electrophysiology team. The telemedicine visit was to discuss results of Holter monitor, plan of care including obtaining a cardiac MRI, and possible therapeutic options.	Mother and father joined conference from two different locations.
22	I49.3	Premature ventricular contractions with different morphologies. The telemedicine visit was to discuss results of a 24-hour Holter monitor.	
23	R07.89	Exercise-induced chest pain. The telemedicine visit was to discuss results of stress test.	Mother was able to clarify a medication by bringing it from their medicine cabinet.
24	Q22.0	d-malposed great arteries, pulmonary atresia with ventricular septum defect (VSD), discontinuous PAs, persistent left superior vena cava to coronary sinus without bridging vein s/p VSD closure and 12 mm Contegra RV-PA conduit. He also has premature ventricular contractions. The telemedicine visit was to discuss results of a 24-hour Holter monitor.	Patient was in day care. Both parents were able to join discussions from the comfort of their home with no interruptions.
25	E78.01	Familial heterozygous hypercholesterolemia.	
26	Q21.1	Large atrial septal defect. Patient underwent a recent sedated echocardiogram. Only three pulmonary veins were noted to enter the left atrium. Case was discussed with interventional cardiologist. The telemedicine visit was to share results and discussions.	

ICD-10, 10th revision of the International Statistical Classification of Diseases and Related Health Problems.

and more studies are needed to fully elucidate optimal billing practices.[12]

Our findings of insurance reimbursement for telemedicine visits at 41% for billed charges was similar to other studies on telemedicine billing in outpatient settings.[13] However to our knowledge, no other studies have compared billing reimbursement between telemedicine visits and in-person clinic visits for pediatric cardiology subspecialty care.

Table 2 Billing data for telemedicine and in-person visits

Item	Telemedicine appointment Mean±SD (n=26)	In-person visit Mean±SD (n=26)	Mean difference (95% CI)	P value
Charges (2019US$)	172.95±54.46	218.27±52.02	45.32 (15.34, 75.30)	0.0046
Insurance compensation (2019US$)	65.18±50.04	110.85±52.79	45.67 (24.73, 66.60)	<0.001
Insurance reimbursement rate (%)	43%±29%	61%±24%	18% (7%, 30%)	0.0029
Patient payment* (2019US$)	11.13±16.15	62.83±49.26	51.70 (29.74 to 73.67)	<0.001
Overall reimbursement rate (%)	43%±29%	82%±31%	39% (25%, 54%)	<0.001
Zero reimbursement (%)	27%	8%	19%	0.131

*95% CI not calculated because data not normally distributed, p value based on non-parametric Wilcoxon signed-rank test.

While our data showed lower charges for patients, there are many other cost savings that result from telemedicine visits that were not explicitly measured. Telemedicine visits have previously been shown to be both efficient and cost-effective.[14] Telemedicine can result in savings on travel and parking costs, time missed from work or school and food costs when compared with in-person clinic visits. In our study, telemedicine resulted in significant reduction in travel time and distance traveled, as the average patient was 35 miles from the in-person cardiology clinic. With the lack of in-person patient check in times or the need to measure vital signs, the duration of patient encounters can be reduced with telemedicine, allowing for more encounters per clinic session. Telemedicine visits are also less likely to be impacted by inclement weather. Overall, the reduction in time associated with telemedicine and convenience of these visits may result in an increase in patient compliance and reduced no-show rates.[15]

The indications for cardiology telemedicine visits show the wide variety of applications for these visits. Telemedicine visits for hyperlipidemia and hypercholesterolemia, which are primarily focused on review of lifestyle and diet, a visual inspection focusing on general body habitus, presence of acanthosis, other key physical examination findings and patient education, are easy, safe and convenient for both providers and families. Telemedicine visits also have the added benefit of allowing providers and clinical teams to visually inspect the contents of the refrigerator/pantry to provide feedback to families on healthy food options.

Follow-up visits for counselling on Holter monitor tests, exercise stress tests, advanced cardiac imaging, second opinions and results of multidisciplinary case-based meetings are other areas where having a billable telemedicine visit is beneficial to both families and physicians. As shown in the example of one family living ~100 miles from our clinic, compared with telephone encounter, a telemedicine visit allows for non-verbal communication to ensure mutual understanding so shared decision making could be made.[16 17] Telemedicine visits can ensure continuity of care between providers and their patients. Telemedicine visits allow for avoidance of risk of exposure to infectious diseases and may help in the fight against COVID-19.[18–20] Patients with complex medical needs can be evaluated without having to travel out of their home thus reducing their chances of acquiring the infection.[21] Asymptomatic children with congenital heart disease may be seen via telemedicine visits during the COVID-19 period with a deferral of their annual cardiac testing (ECG, echocardiogram) to a later time. Telemedicine visits allow for billing and insurance reimbursement as shown in this study. As there are financial and time constraints on families and providers, telemedicine visits provide face-to-face encounters that do not require time off work or travel associated with an in-person clinic visit.

Limitations

This study has several limitations: (1) the study was limited to a single center including only patients with previously established in-person visits, resulting in a small sample size, (2) no feedback from patients/families was included. We did survey all patients/families following all telemedicine visits in our health system, however response rates were low and we were not able to separate out the responses for these cardiology patients and (3) only patients with successful telemedicine visits were included in this study. Further study is needed to assess racial and economic disparities in access to telemedicine.

CONCLUSION

In this pre-COVID small sample study, families saved time and cost with telemedicine visits. No adverse outcomes were found. Insurance reimbursement and out-of-pocket payment for telemedicine visits were less than for in-person visits.

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