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Cost and Satisfaction Implications of Using Telehealth for Plagiocephaly

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Purpose: Patients with deformational plagiocephaly are often referred for evaluation by a plastic surgeon. During the early COVID-19 pandemic, visits were performed predominantly via telehealth. This study compares costs, satisfaction, and technological considerations for telehealth and in-person consultations for plagiocephaly.
Methods: This prospective study evaluated telehealth and in-person consultation for plagiocephaly between August 2020 and January 2021. Costs were estimated using time-driven activity-based costing (TDABC) and included personnel and facility costs. Patient-borne expenses for travel were assessed. Post-visit questionnaires administered to patients' families and providers measured satisfaction with the consult and technical issues encountered.
Results: Costing analysis was performed on 20 telehealth and 11 in-person consults. Median total personnel and facility costs of providing in-person or telehealth consults were comparable ($P > 0.05$). Telehealth visits saved on the cost of clinic space but required significantly more of the provider's time ($P < 0.05$). In-person visits had an additional patient-borne travel cost of $28.64. Technical difficulties were reported among 25% (n = 5) of telehealth consults. Paired provider and patient experience questionnaires were collected from 17 consults (11 telehealth, six in-person). Overall satisfaction with care did not differ significantly between consult types or between the provider and patient family ($P > 0.05$).
Conclusions: Costs of providing in-person and telehealth plagiocephaly consultations were comparable, whereas patients incur greater costs when coming in person. Practices that treat patients with plagiocephaly may wish to consider expanding their virtual consult offerings to families desiring this option. Long-term outcome studies are necessary to evaluate the efficacy of both visit types. *(Plast Reconstr Surg Glob Open 2022;10:e4392; doi: 10.1097/GOX.0000000000004392; Published online 20 June 2022.)*

INTRODUCTION

Deformational plagiocephaly is flattening of the skull resulting from sustained positional pressure during infancy.[1] At our institution, management for plagiocephaly begins with consultation by a craniofacial plastic surgeon, who confirms the diagnosis and makes a recommendation on the potential benefit of orthotic helmeting. During the early COVID-19 pandemic, a majority of these initial outpatient visits were performed via telehealth, given the constraints of social distancing. As provider and health systems consider the use of telehealth moving forward, it is worthwhile to investigate satisfaction and cost implications for telehealth and in-person evaluations of plagiocephaly.

Time-driven activity-based costing (TDABC) provides an objective assessment tool to estimate costs for various medical services based on projections of cost per minute of various services. It has been used to improve patient care and illuminate inefficiencies in the treatment of distal radius and hip fractures and detection of cancer; within craniofacial surgery, it has previously been used for process improvement in outpatient plagiocephaly care as well for calculating costs of surgical interventions including the use of presurgical infant orthopedics in cleft lip and palate.[2–10]

This study compared hospital-based and patient-incurred expenses for both in-person and telehealth visit

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types. We also gauged patient and provider desire for and satisfaction with each visit type while weighing technological considerations for telehealth consultations. Continuation of telehealth for specific diagnoses will likely depend on such demand and cost-efficiency analyses.

METHODS

Patient Selection

This was a prospective study of patients treated for deformational plagiocephaly between August 2020 and January 2021 at a tertiary care center. Infants evaluated were all under 1 year of age. Initial consults were performed via telehealth or in person by three surgeons. Telehealth was used when preappointment photographs could be obtained showing birds-eye, frontal, lateral, and posterior views of the head shape. In-person visits were arranged if this was not possible due to hair growth or family's lack of appropriate technology (camera/email) to send photographs in advance for review. Providers were also able to refer patients for in-person consults if there were additional concerns that came up during the telehealth consult itself. Consultations during the study period were not included in the study if they were scheduled without sufficient time to notify the researcher to coordinate recording timings. Patients were included regardless of need for interpreter services. The study was done as a quality improvement project in accordance with the Declaration of Helsinki.

Costs

Cost of Providing Care

This study used TDABC to assess cost of providing care for telehealth and for in-person consults. TDABC is a comprehensive costing metholodogy employed in the study of health care efficiency.[7–9] Cost of care is calculated by multiplying the precise amount of time a patient's care utilizes various resources (provider, facility, equipment, etc.) by the unit cost of those resources. (**See figure, Supplemental Digital Content 1**, which displays TDABC calculation for cost of care, **http://links.lww.com/PRSGO/C84**.)

Personnel Capacity Rates

Personnel capacity rate refers to the cost per unit time for a provider's care and was derived from the national mean annual wages, as outlined in the US Bureau of Labor Statistics.[11] Personnel capacity rate per minute (CPM) was calculated by dividing mean annual wage by a total annual capacity of 93,060 minutes, which includes 8.8 clinical hours for a typical work day, 5 days worked per week, and 47 weeks worked per year.

Facility Capacity Rates

Facility costs were estimated using overhead costs of the outpatient clinic space used for in-person consults. Cost per in-person visit was calculated from the duration of the visit reported by providers and the CPM of clinic space. Facility costs for telehealth were $0 during the study period, since they were completed from providers' homes.

Takeaways

Question: Are there differences in cost or satisfaction with telehealth or in-person visits for plagiocephaly?

Findings: This study found that total costs of providing in-person and telehealth consults for plagiocephaly were comparable. Although telehealth consults required more of the provider's time, they utilized less costly space. In-person consultations incurred additional patient-borne travel expenses. Overall satisfaction did not differ between consult types or between provider and family.

Meaning: Practices that treat patients with plagiocephaly may wish to consider expanding their virtual consult offerings to patients to improve access to care and decrease cost burden on their families.

However, to better reflect care in a post–COVID-19 model, a hypothetical calculation was additionally done using cost per minute of office space onsite, assuming that telehealth and in-person visits may be blended throughout a provider's day.

Process Mapping

The TDABC process began with mapping clinical flows for telehealth and in-person consults. Elements of care were mapped starting with preappointment scheduling and continuing through all stages of care, concluding at the end of the telehealth or in-person appointment. (**See figure, Supplemental Digital Content 2**, which displays the process maps of telehealth and in-person consultations, **http://links.lww.com/PRSGO/C85**.)

Timing

Timing began at the first patient phone call to schedule the appointment, in which schedulers for three different craniofacial providers logged the total time spent on the phone arranging the consult. The number of follow-up phone calls and total time required to collect necessary preclinical documentation and/or photographs was recorded. Schedulers additionally disclosed issues or challenges faced during the appointment making process and all time spent on later changes and/or cancelations. In-person visits required the scheduler to be on site, sitting at the front desk to help patients check in and out, validate parking, and assist with questions. Scheduler costs on the day of in-patient visits were calculated based on their salary capacity rate multiplied by the number of minutes staffing the front desk for that clinical session and divided by the total number of patients seen in that clinic session.

Once a virtual visit was scheduled, a research team member then electronically distributed a timing questionnaire, generated via a secure REDCap databse, for providers to complete during or after the telehealth or in-person consult. Questionnaires were distributed to the surgeon and the physician assistant jointly involved in assessing the patient. Each provider was required to complete questions related to the time they spent reviewing preclinical information and/or photographs, the time that the patient logged into the virtual platform, and the duration of the consult.

In-person visits were timed by a research assistant who tracked the patient through their clinic visit, recording time spent in clinic and specifically with each staff including the clinical assistant, physician assistant, and physician.

Only consults for which timings of all steps were recorded were included in our costing analysis; consults were excluded if any timings were not captured. The sum of all personnel and facility costs was calculated for each visit. Median costs for each visit type were then calculated (Table 2).

Patient-borne Costs

Average travel costs were included for in-person consults and were comprised direct costs borne by the family, including mileage and parking fees. To estimate travel costs, it was assumed that all patients traveled via car to in-person consults. Costs were calculated using driving distances listed by Google Maps from the patient's home address to the hospital. To illustrate differences in travel cost for urban versus suburban settings, we calculated the travel cost both with the standard parking fee at our institution and also without parking fees, as this may better represent costs of care in other geographic settings. Indirect costs, including time taken off from work, lost pay, and opportunity cost, were excluded in our analysis, although we calculated the anticipated travel time to and from the visit to better describe the additional effort that such a visit entails. Patient-incurred billing fees for each consult were additionally derived from current procedural terminology (CPT) codes and compared between telehealth and in-person visits.

Provider and Patient Satisfaction

Provider and patient experiences were evaluated using postconsult questionnaires designed for this study. Surgeons involved in the study were polled for key components of satisfaction. These themes were incorporated into questions including satisfaction with visit type, ability to conduct adequate examination, time for questions and explanations, and confidence in diagnosis. The surveys for providers were distributed electronically via REDCap along with the timing questionnaire. Questions were asked on a five-point Likert scale designed to assess overall satisfaction with consult type.

Questionnaires were also distributed electronically to patients' families after the consult. These surveys were designed ad hoc for this study and were based on hospital-based post-visit surveys with modifications and additions specific to in-person and telehealth visit types. These questions mirrored the provider survey and included additional questions about ease of planning and scheduling the appointment and future-state desire for the pertinent visit type. Family survey questions were also asked on a five-point Likert scale. Median satisfaction scores were recorded for all provider and for all patient family surveys. Difference between provider and patient family satisfaction was assessed using only the consultations in which both sets of surveys were completed.

Technology Considerations

In post-visit surveys for telehealth encounters, providers and patients also indicated any technical difficulties they experienced accessing and completing the visit.

Statistical Analysis

Statistical analyses were performed using SPSS Statistics for Windows version 24.0 software (IBM Corp, Armonk, N.Y.). As data were nonnormally distributed, Mann–Whitney U tests were performed for all costing and satisfaction analyses.

RESULTS

During the study period, 33 telehealth visits and 25 in-person visits were timed. None of the patients having initial telehealth visits were additionally arranged for in-person examination out of diagnostic uncertainty.

Costing Analysis

TDABC was performed on 20 teleheath and 11 in-person consults for which complete detailed timings were recorded. Table 1 breaks down distribution of visits among three surgeons, as well as duration of visits for each provider. Among 31 visits included in our costing analysis, surgeon 1 completed six telehealth and one in-person consult, surgeon 2 completed six telehealth and seven in-person consults, and surgeon 3 completed eight telehealth and three in-person consults. Physician assistants participated in patient intake and assessment along with the craniofacial providers for 17 (85%) of all telehealth consults and seven (63.6%) of all in-person consults.

Elements of cost are broken down in Table 2 and discussed below. Median total cost of providing a telehealth consult at our institution was $97.81. The majority of the total cost was associated with time spent by the surgeon conducting the visit ($63.69, 65.1% total cost). Likewise, the majority of the total median cost for in-person consults ($99.35) was associated with time spent by the surgeon ($40.65, 40.9% total cost). Telehealth visits required significantly more of the surgeon's time compared to in-person visits ($P < 0.05$), the majority of which was attributable

Table 1. Distribution of Visit Type by Surgeon

	Telehealth (n = 20)	Duration of Telehealth Visit (min, Range)	In-person (n = 11)	Duration of In-person Visit (min, Range)	Total No. Consults
Provider					
Surgeon 1	6 (30%)	9–19	1 (9%)	16	7
Surgeon 2	6 (30%)	14–18	7 (63.6%)	7–28	13
Surgeon 3	8 (40%)	12–20	3 (27.3%)	10–15	11
Consult accompanied by PA	17		7		24

Table 2. Cost of Providing Care (Per Visit)

Facility/Personnel	Telehealth (n = 20 Consults)	In-person (n = 11 Consults)	*P*
Scheduler/front desk			
Scheduler time (min)	4.00	5.00	
Scheduler CPM	$0.34	$0.34	
Scheduler cost	$1.36	$1.70	>0.05
Clinical assistant			
Clinical assistant time (min)	—	4.00	
Clinic assistant CPM	—	$0.40	
Clinic staff cost	—	$1.60	
Physician assistant			
PA time (min)	26.00	31.00	
PA CPM	$1.20	$1.20	
PA cost	$31.20	$37.20	>0.05
Surgeon			
Surgeon time (min)	23.50	15.00	
Surgeon CPM	$2.71	$2.71	
Surgeon cost	$63.69	$40.65	>0.05
Clinic space			
Clinic time (min)	—	26.00	
Clinic cost/minute (CPM)	—	$0.70	
Clinic cost	—	$18.20	
Virtual office space			
Office space time (min)	52.33	—	
Virtual office space cost/minute	$0.03	—	
Office space cost	$1.57	—	
Total cost	$97.81	$99.01	>0.05

to time designated as reviewing patient provided photographs in advance of the telehealth consult (average 5.1 minutes) and which translated into a significant cost differential between visit type for surgeons ($P < 0.05$). The most common CPT code used was 99202, and the additional time spent on telehealth versus in-person visits did not produce a significant difference ($P > 0.05$) in CPT billing codes that were submitted, when comparing between the visit types.

Telehealth visits saved on the cost of clinical space ($18.20 for in-person consults, 18.3% total cost), while requiring additional office space when conducted from the hospital ($1.57, 1.6% of total cost). In-person visits had an additional cost of $28.64 for patient-borne travel expenses, including gas and onsite parking fees (Table 3). Median front desk costs for in-person consults ($1.70) were comparable to telehealth ($1.36) ($P > 0.05$). Overall, median total personnel and facilities cost of providing an in-person or telehealth consult were comparable ($P > 0.05$).

Provider and Patient Experience Evaluation

Median experience scores were calculated based on the total 53 provider responses and 24 patient family responses (Table 4). Scores were not significantly different ($P > 0.05$) between in-person and telehealth visits for either group.

Fully completed paired provider and patient experience questionnaires were collected from 11 telehealth and six in-person consults. This sample was underpowered to assess significant differences, but it is notable that provider satisfaction was the same for both visit types and patient family satisfaction was slightly higher with telehealth than in-person visits (5.0 versus 4.5) during the study period (Table 5).

Technology Considerations

Technical difficulties were reported among five telehealth consults (25% of all telehealth consults). Difficulties experienced included poor audio quality (n = 3 telehealth consults), internet connection (n = 2), and video quality (n = 1). All visits were completed despite the intermittent issues reported, which added an average of five minutes to those telehealth consults. Families who experienced technical difficulties during their consult remained satisified with their telehealth visit, as noted in postconsult questionnaires (5.0 score).

DISCUSSION

COVID-19 required healthcare providers and administrators to re-evaluate the way in which care is provided. Telehealth utilization surged in an effort to provide medical care while transitioning through a global pandemic. As a result, the benefits of this previously underutilized technology are now more widely recognized.[12] In the field of plastic surgery alone, virtual clinics developed for the triage of hand trauma reveal the potential of telehealth as a successful alternative to in-person consultation, with accuracy of presurgical assessment comparable in both settings.[13] Telehealth has also been well established in the setting of virtual surgical planning.[14] These examples have considerable implications in improving access to care for patients. As we continue to evaluate the demand for future telehealth consults for various conditions seen in plastic surgery clinics, it is prudent to determine the associated cost and resource utilization of each modality (telehealth versus in-person) to optimize care from a systems-based approach. For the purpose of this study, we chose to focus on deformational plagiocephaly due to the typically high volume of outpatient clinic visits for this diagnosis at our institution.

Use of TDABC in evaluating the relative value of telehealth to traditional care models is limited to a single study comparing the cost of radiation oncology consultations, which reported significant cost savings with telehealth, not only to patients in time and travel costs but also to providers based on the assumption that this enabled them to work remotely and save on commuting costs.[5] Other

Table 3. Patient-borne Costs (for In-person Consultations)

Consult Type	Mid-day Traffic Travel Time (Round Trip)	Median Travel Distance	Mileage Cost ($0.57 per Mile)	Parking Fee	Total Estimated Travel Cost
In-person	110 min	32.7 miles	$18.63	$10	$28.63
Urban				$10	
Suburban				$0	
Telehealth	0	0	0	0	0

Table 4. Provider and Family Satisfaction Scores

Postconsult Patient Family Questionnaire	Telehealth (n = 16 Visits)	In-person (n = 8 Visits)	*P*
Rate the following questions based on your experience today:			
How do you rate your overall experience in the ease of MAKING this appointment?	5	5	0.569
How do you rate your overall experience in the ease of ATTENDING this appointment?	5	5	0.610
How do you rate the convenience of this appointment?	5	5	0.452
How clear were the instructions on how to take the preappointment photographs?	5	NA	
How easy was it to take the preappointment photographs?	5	NA	
How do you rate the overall medical care you/your child received today?	5	5	0.452
Rate the following questions based on your agreement with the following statements:			
Were you satisfied when you were offered a virtual visit for this appointment?	5	NA	
It was easy to schedule this appointment	4.5	5	0.742
I felt that I could ask all the questions I needed to in this appointment	5	5	0.976
I felt that all of my questions were answered during this appointment	5	5	0.928
I felt that my provider was able to thoroughly assess my child's head shape	5	5	0.192
My provider had all the information they needed to assess my child	4.5	5	0.417
I feel confident in the treatment plan my provider presented	5	5	0.569
I liked this type of appointment	5	4.5	0.697
With ongoing COVID-19 concerns, I would want my future appointments to be the same as this appointment type	4	4	0.653
When there are no longer COVID-19 concerns, I would want my future appointments to be the same as this appointment type	3.5	4	0.136
Postconsult Provider Questionnaire Results	**Telehealth (n = 30 Visits)**	**In-person (n = 23 Visits)**	***P***
Rate the following questions based on your experience today:			
How do you rate your overall experience in the ease of planning and attending this appointment?	5	5	0.593
How do you rate the convenience of this appointment?	5	5	0.893
How do you rate the overall medical care you were able to provide today?	5	5	0.593
Rate the following questions based on your agreement with the following statements:			
I felt I could properly assess this patient during the appointment	5	5	0.336
The quality of the information and/or photographs presented allowed for full assessment of this patient	5	5	0.195
I was able to gather all the information I needed during this appointment	5	5	0.893
I was able to adequately examine the patient's head shape at this appointment	4.5	5	0.893
I felt the patient/family was receptive to this appointment	5	5	0.893
All the patient/family's questions were able to be answered in this appointment	5	5	0.893
All requested preclinical information needed to assess this child was available to me	5	5	0.593
The family seemed confident that this type of visit addressed all their questions and concerns	5	4.5	0.593

TDABC studies on telehealth assess the estimated value of offering new interventions such as physical therapy services for functionally impaired individuals during the pandemic[15] and ostomy teaching,[16] without a direct in-person care alternative. There is currently no evidence in the literature directly comparing cost associated with in-person and telehealth consults for craniofacial conditions. The aim of this study was to compare hospital-based and patient-borne expenses for, as well as overall patient and provider satisfaction with, telehealth and in-person consultations for plagiocephaly.

Costing Analysis

Within our study population, we found a $30.18 ($127.99 versus $97.81) decrease in the comprehensive cost of providing and receiving care when evaluating patients via telehealth. This was largely due to the lack of patient-borne travel expenses and decreased cost of hospital space necessary to provide such care. When excluding travel costs, there was only a non-significant $1.20 ($97.81 versus $99.01) decrease in cost when providing telehealth care compared to in-person care ($P > 0.05$). Telehealth consults also saved on the cost of using clinic space (approximately $18.20 per in-person visit), but incurred an additional cost of $1.57 associated with the use of office space by providers to conduct telehealth consults. Despite cost savings associated with limited physical resources required to facilitate a telehealth consult, these visits had increased demand on the physician's time. This study found that the cost associated with time spent by the attending physician was $23.04 more (56.7% increase) when seeing patients virtually. This additional time, though, did not correspond with differences in charges billed to families when broken down by CPT code.

Table 5. Paired Provider/Family Satisfaction

Median Overall Satisfaction Score	Telehealth (n = 11 Visits)	In-person (n = 6 Visits)
Patient family	5.0	4.5
Provider	5.0	5.0

Paired Provider and Patient Experience Evaluation

For providers and patients' families who completed postconsult questionnaires, there was no difference in satisfaction between consult type among providers or between providers and patient families when assessing paired feedback ($P > 0.05$). Results indicated that both providers and parents thought that thorough assessment of the infant's head was attained in both settings, and confidence was shared between provider and family in regards to next steps in care. Provider responses indicated that pre-telehealth review of clinical documentation and photographs enabled them to adequately examine the patient's head shape. This is consistent with other studies reporting high levels of provider confidence in telehealth

effectiveness[17–19] and moderately positive physician experiences which was much higher when the audiovisual quality was high.[20]

The timing of this study during a pandemic may have influenced overall satisfaction with telehealth consults. A prepandemic study on satisfaction with telehealth for cardiology visits emphasized the need to optimize technology and scheduling to reduce provider fatique.[21] The body of literature on outpatient telehealth has grown during the pandemic, when providers and patients may have more positively viewed telehealth due to a combination of exposure risks with in-person visits and other logistical considerations at a time many families were working and attending school from home. Patients in our study only moderately endorsed a desire for telehealth in the future when COVID-19 was not longer a concern. Other reported physician surveys indicate a gradual deline in satisfaction with telehealth from the peak of the pandemic in 2020 (64% satisfaction) to July 2021 (58% satisfaction).[22] In a profession susceptible to burnout and fatigue, it will be critical to assess changes in overall satisfaction with telehealth over time.

Technology Considerations

As technical difficulties were reported among 25% of telehealth consults, these should be considered when offering virtual evaluations. Patients from disadvantaged socioeconomic backgrounds may lack access to reliable technology to participate in such telehealth visits. Although in the study period there were no telehealth consults that required interpreter services, among non-English speaking families there may be additional challenges that arise when interpreter services also need to be connected through a reliable telehealth platform.

Despite these hurdles, familiarity with using telehealth platforms has increased tremendously over the past 2 years. As of February 2021, telehealth insurance claim volumes increased 38 times their pre–COVID-19 rates.[22] This has provided both physicians and patients the opportunity to become more familiar and technically adept with the implementation of telehealth in daily practice. As telehealth consults continue to be performed, the same technical challenges that arose at the time of this study may dissolve as providers and patients become more acquainted with this service.

Limitations

This study is limited by being conducted during the COVID-19 pandemic. Patient and provider satisfaction with telehealth may not be generalizable in the postpandemic setting, when immediate concerns about in-person exposure risk is diminished. Growing familiarity with telehealth platforms will likely decrease technical issues and improve consult efficiency. Furthermore, the onus of travel may be magnified as companies, schools, and other institutions return to normal patterns, leading to increased commuter traffic and more time spent traveling to and from in-person consults. We acknowledge that in quantifying expenses borne by families, we did not consider indirect family costs in our analysis, including time taken away from work and resulting lost income or vacation time to attend in-person consults, which may be a lasting impetus for some families to seek telehealth care for various conditions. Another limitiation is the potential impact of recall bias; in-person visits were precisely timed by a research assistant, whereas time associated with telehealth visits was reported by the provider. Additionally, a number of visits during the study time period, including 13 telehealth and 14 in-person visits were excluded from the TDABC analysis due to missing data points, and this resulted in a small overall sample size and unequal distribution of consult types performed by different craniofacial providers. Systematic differences may exist between the included and excluded visits. Last, this study did not evaluate the efficacy of telehealth visits in ruling out craniosynostosis. It is possible that parent-provided photographs and medical histories were insufficient to accurately make this distinction.

CONCLUSIONS

In this study, we found that costs of providing in-person and telehealth plagiocephaly consultations were comparable, but that patients incur greater costs when coming in person. Practices that treat patients with plagiocephaly may wish to consider expanding their virtual consult offerings to families desiring this option. Postpandemic provider and patient satisfaction with telehealth will need to be monitored, and long-term outcome studies are necessary to evaluate the efficacy of both visit types.

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