







Telemedicine use for pediatric asthma care: a mixed methods study

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ABSTRACT

Objectives: To identify factors associated with telemedicine use for asthma care among children and young adults, and to describe the parent and patient experience of asthma care over telemedicine.

Methods: Our mixed methods study consisted of an electronic health record analysis and a qualitative focus group analysis. We analyzed records for all patients aged 2–24 seen at UC Davis Health between March 19, 2020 and September 30, 2020 for a primary diagnosis of asthma. We performed multivariable logistic regression to quantify the relationships between patient characteristics and telemedicine use. We also conducted focus groups with parents and patients who received asthma care during the study period and used qualitative content analysis to identify themes from the transcripts.

Results: 502 patients met the inclusion criteria. Telemedicine use was significantly lower among patients with a primary language other than English (OR = 0.12, 95% CI: 0.025–0.54, $p=0.006$), school-aged children (OR = 0.43, 95% CI: 0.24–0.77, $p=0.005$), and patients who received asthma care from a primary care provider instead of a specialist (OR = 0.55, 95% CI: 0.34–0.91, $p=0.020$). Six thematic categories emerged from focus groups: engaging with the patient, improving access to care, experience of visit, measurements, scheduling, and the future of telemedicine in asthma care.

Conclusions: Alternating telemedicine with in-person visits for asthma care may result in improved access to care and reduced burdens on patients and families. Providers and researchers should work to understand the specific reasons for low telemedicine use among non-English speaking patients so that these patients receive equitable access to care.

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Introduction

Asthma is the most common health condition among young people in the United States, affecting around 8% of children and young adults (1) and accounting for nearly \$6 billion in healthcare spending for school-aged children alone (2). Children with asthma experience more than double the number of missed school days compared to children without asthma and experience negative impacts on quality of life (3–5). Routine care from primary care providers and specialists has been shown to improve outcomes and lessen the burden of asthma by optimizing medication management, providing patient education, and implementing patient-centered management plans (6). Telemedicine provides an opportunity to increase

access to care, particularly considering the increasing regionalization of pediatric asthma care (7). Due to shelter-in-place orders and efforts to minimize in-person encounters, the COVID-19 pandemic led to a drastic increase in the use of telemedicine visits for asthma (8). However, little is known about which patients successfully adopted telemedicine for asthma care during the pandemic, and how patients and families experience telemedicine visits for asthma care. Because telemedicine is likely to continue to play a significant role in pediatric asthma care after the conclusion of the pandemic (8), it is essential to better understand the use and utility of telemedicine for this patient population in order to identify best practices, inform policies, and ensure equitable access.

The purpose of this study was to better understand the use of telemedicine (defined here as synchronous audio-visual encounters between providers and patients in different locations) for asthma care among pediatric and young adult patients during the pandemic in order to inform the future of telemedicine care for asthma. To do this, we conducted a sequential mixed methods study comprising an electronic health record (EHR) analysis and a qualitative focus group analysis. We first evaluated the association of patient characteristics such as age, sex, race, ethnicity, primary language, urban/rural residence, and distance to University of California (UC) Davis Health with telemedicine use; we then collected deeper insights about telemedicine use for outpatient asthma care through focus groups with parents and patients.

Methods

EHR analysis

We abstracted data from the UC Davis EHR on all patients ages 2–24 who had any visit for a primary diagnosis of asthma during the six months following California's statewide shelter-in-place order (March 19, 2020–September 30, 2020). We chose to include young adults (ages 18–24) in our analysis of pediatric asthma care because many of these patients are still seen in pediatric pulmonology clinics as they transition to independent care. Our outcome of interest was telemedicine use for healthcare encounters with a primary diagnosis of asthma. Data abstracted included the visit type (in-person, telemedicine, or phone), clinical department, and patient sex, age, race/ethnicity, primary language, insurance, and zip code. We matched patient zip codes to the Federal Office of Rural Health Policy (FORHP) list of eligible zip codes to identify rural/urban residence (9). We calculated driving distance from the patient's home to the UC Davis Health ambulatory clinic using the *gmapsdistance* package in R (version 3.6.1) to connect to the Google Maps Distance Matrix Application Programming Interface (10,11). As this interface requires using an estimated future time to do the calculations, we used July 7th, 2020 10:00AM to estimate driving times during the day without the influence of morning rush hour. These calculations were completed in February 2020, before the California shelter-in-place affected traffic patterns.

We grouped clinical departments into primary care (general pediatrics, family practice, and internal medicine) and specialty care (pulmonology and allergy). We calculated descriptive statistics, including numbers

and percentages for each variable and mean and median for distance from the medical center. We calculated unadjusted *p* values for each variable using chi-squared tests. We fit a multivariable logistic regression model to assess the association of telemedicine use with sex, age, race, insurance, primary language, primary vs. specialty care, rural/urban residence, and distance to UC Davis Health. These factors were identified *a priori* as factors of interest. We calculated the odds of telemedicine use and 95% confidence intervals for each factor, adjusted for the other covariates. We used interaction terms to examine effect modification by each covariate; interaction terms were excluded from the final model if they were not significant at a *p*=0.05 level. All statistical analyses were completed in Stata version 16.1 (12).

Qualitative focus group analysis

To gain a deeper understanding of telemedicine adoption for asthma care, we conducted focus groups with a random sample of patients and parents. Participants were eligible for the focus group if they were a parent of a patient aged 2–17 or a patient aged 18–24 who had a visit with a primary diagnosis of asthma during the study period. We excluded parents and patients who did not speak English because we did not have the resources to conduct and analyze focus groups in other languages. We recruited parents and patients by phone from the list of patients from the EHR analysis, using Stata's random number generator. Participants provided informed consent electronically and received a \$50 gift card for their participation. Participants also provided demographic information through a brief survey.

Authors worked together to develop a semi-structured discussion guide with questions related to the use of asthma care for telemedicine during the pandemic and in the future. However, focus group participants were encouraged to converse with each other rather than answering specific questions from the moderator; therefore, the discussion guide was only used to refocus the discussion when necessary. Focus groups were conducted over videoconference, lasted one hour, and were moderated by a telemedicine researcher (SH) with assistance from a graduate student (SK). A pediatric pulmonologist (RK) and a general pediatrician (CK) also attended the focus groups, to ask relevant follow-up questions and provide clinical insights into the responses. Following each focus group, these four authors met to discuss initial insights and to make changes to the discussion guide for the following group.

Focus groups were audio recorded and transcribed using principles of conventional content analysis (13). Two coders (SH and SK) independently read and coded the first transcript using a combination of structural codes (based on *a priori* concepts included in the discussion guide) and process codes, which identify actions in the data (14,15). After coding the first transcript, the coders reviewed the transcript line by line to find alignment and discordance in coding and to refine codes and definitions. All coding was completed using Dedoose Qualitative Software (16). After independently coding the final two transcripts, we reviewed categories and themes with the entire research team and discussed interpretations. We planned to conduct three focus groups, with the possibility of adding additional focus groups until thematic saturation was reached.

Both the quantitative and qualitative components of this study were approved by the UC Davis Institutional Review Board.

Results

EHR analysis

Between March 19, 2020 and September 30, 2020, a total of 502 patients aged 2–24 were seen for asthma care at UC Davis Health, as defined by a visit with a primary diagnosis of asthma. Of these patients, 207 (41.2%) had at least one telemedicine visit. Of the remaining 295 patients, 265 had in-person visits only, 27 had telephone visits only, and 3 had a combination of in-person and telephone visits. Table 1 shows characteristics of the study population. Most patients were male (57.6%), lived in urban areas (85.5%), spoke English as a primary language (96.0%), and had private insurance (65.5%). One quarter of patients (24.5%) identified as Hispanic or Latino, 9.0% identified as Asian, and 8.4% identified as Black; the remaining 40.1% identified as Caucasian/White. Around one-fifth of patients (20.2%) lived further than 50 miles from the UC Davis Children's Hospital. Most study participants (61.8%) were seen only in specialty care for asthma during the pandemic, while 35.5% were seen only in primary care; 2.8% were seen in both primary and specialty care for a primary diagnosis of asthma. By restricting to a primary diagnosis of asthma, our sample includes a larger percentage of patients with moderate to severe persistent asthma as compared with the entire population of children and young adults with asthma.

Table 2 shows the adjusted odds ratios and corresponding 95% confidence intervals for telemedicine

adoption during the first six months of the pandemic (March 19, 2020–September 30, 2020). Patients who spoke a primary language other than English were much less likely than English-speaking patients to adopt telemedicine for asthma care during the pandemic (OR = 0.12, 95% CI: 0.025–0.54, $p=0.006$). Patients who received asthma care exclusively from a primary care provider during the study period were less likely to use telemedicine than those who received specialty asthma care exclusively (OR = 0.55, 95% CI: 0.34–0.91, $p=0.02$). Parents of school-aged children (aged 6–12) were significantly less likely to adopt telemedicine for asthma care as compared with young adults (OR = 0.43, 95% CI: 0.24–0.77, $p=0.005$), while no significant differences were seen among other age groups. We found no association between telemedicine use and urban/rural residence, sex, insurance status, distance to UC Davis, or race/ethnicity.

Qualitative focus group analysis

We conducted three focus groups in April and May of 2021, after which the research team determined that thematic saturation had been reached (previous research suggests that at least 80% of themes will be identified in two or three focus groups (17)). Focus groups comprised 12 parents of pediatric patients and 5 young adult patients. All participants were female; 9 identified as White, 4 identified as Asian, 3 identified as Hispanic or Latino, and 1 identified as Black. Young adult patients had a median age of 20, while children of parent participants had a median age of 10. Fourteen participants had used telemedicine for at least one visit for asthma care during the study period, ten had used both in-person and telemedicine visits, and three had chosen to not use telemedicine for asthma care. Calculation of Cohen's Kappa statistic found substantial agreement between coders ($\kappa=0.71$) (18). Six major categories emerged from analysis of focus group data: 1) Engaging with the patient, 2) Improving access to care, 3) Visit experience, 4) Measurements, 5) Scheduling, and 6) Future use of telemedicine for asthma care. Categories and themes are discussed in detail below and are summarized in Table 3.

Category 1: engaging with the patient

Participants consistently compared the ways that providers engaged with patients through telemedicine and in person, highlighting unique aspects of telemedicine that influence (both positively and negatively) the ways that providers and patients interact. Both parents and patients experienced telemedicine visits with a new

Table 1. Study population.

	All patients, N(%)	In-person or telephone care only, N (row %; column %)	Telemedicine care, N (row %; column %)	p-value*
Age				
Young adults (18–24)	101 (20.1)	53 (52.5; 18.0)	48 (47.5; 23.2)	0.102
Adolescents (13–17)	119 (23.7)	71 (60.0; 24.1)	48 (40.3; 23.2)	
School-aged (6–12)	170 (33.8)	112 (65.9; 38.0)	58 (34.1; 28.0)	
Preschool-aged (2–5)	112 (22.3)	59 (52.7; 20.0)	53 (47.3; 25.6)	
Urban/rural residence				
Urban	429 (85.5)	253 (59.0; 85.8)	176 (41.0; 85.0)	0.487
Rural	73 (14.5)	42 (57.5; 14.2)	31 (42.5; 15.0)	
Sex				
Female	213 (42.4)	120 (56.3; 40.7)	93 (43.7; 44.9)	0.571
Male	289 (57.6)	175 (60.6; 59.3)	114 (39.5; 55.1)	
Primary language				
English	482 (96.0)	277 (57.5; 93.9)	205 (42.5; 99.0)	0.002
Language other than English	20 (4.0)	18 (90.0; 6.1)	2 (10.0; 1.0)	
Insurance				
Private	329 (65.5)	191 (58.1; 64.8)	138 (42.0; 66.7)	0.471
Public	173 (34.5)	104 (60.1; 35.3)	69 (39.9; 33.3)	
Type of asthma care received				
Specialty care only	310 (61.8)	177 (57.1; 60.0)	133 (42.9; 64.3)	0.204
Primary care only	178 (35.5)	112 (62.9; 38.0)	66 (37.1; 31.9)	
Both specialty and primary care	14 (2.8)	6 (42.9; 2.0)	8 (57.1; 3.9)	
Distance to UC Davis Health				
≤10 miles	111 (22.1)	64 (57.7; 21.7)	47 (42.3; 22.7)	0.091
11–25 miles	184 (36.7)	116 (63.0; 39.3)	68 (37.0; 32.9)	
26–50 miles	106 (21.1)	60 (56.6; 20.3)	46 (43.4; 22.2)	
51–100 miles	48 (9.6)	30 (62.5; 10.2)	18 (37.5; 8.7)	
>100 miles	53 (10.6)	25 (47.2; 8.5)	28 (52.8; 13.5)	
Mean distance in miles (SD)	40.2 (51.2)	36.5 (44.1)	45.5 (59.6)	
Median distance in miles (IQR)	21.0 (12.1, 42.8)	21.0 (12.1, 41.0)	21.0 (12.1, 45.9)	
Race/ethnicity				
White	206 (41.0)	112 (54.4; 38.0)	94 (45.6; 45.4)	0.079
Hispanic	123 (24.5)	72 (58.4; 24.4)	51 (41.5; 24.6)	
Asian	45 (8.9)	31 (68.9; 10.5)	14 (31.1; 6.8)	
Black	42 (8.4)	26 (61.9; 8.8)	16 (38.1; 7.7)	
Other or unknown	86 (17.1)	54 (62.8; 18.3)	32 (37.2; 15.5)	
TOTAL N	502	295	207	502

*Unadjusted *p* values calculated using chi-square tests.

provider to be difficult, expressing that it was difficult to establish trust and rapport with a new provider over telemedicine (*Theme: Difficulty establishing therapeutic alliance over telemedicine*). Parent participants also felt that a physician's in-person presence was more effective for counseling pediatric patients about the importance of medication adherence and other management behaviors and teaching them about asthma (*Theme: Physician presence facilitating receptiveness to patient counseling and education*). As one parent participant stated,

"I prefer the in-person visit because my kid knows that he has seen a doctor, and he has to take this medication. Otherwise I would have to convince my kid, and he would say, 'no you're making me take this medication because you want me to do that'. So, it's a little bit easier to convince them because they've seen a doctor and they've told them you have to do it."

Similarly, parents felt that pediatric patients were more actively engaged in the visit when the visit was in-person (*Theme: Engaging pediatric patients as active participants*). One parent remembered,

"My daughter wasn't really willing to do the telemedicine...when we're in the office she is more willing to interact and participate so for us, yeah she was kind of like ok you talk to him I'm going to go."

Finally, telemedicine visits were more likely to have included only the physician, rather than the entire care team. Parents and patient participants saw this as a benefit of telemedicine (*Theme: Concentrating visit time with the physician*) instead of as a limitation. One parent participant recalled,

"My son, there's sometimes we've seen the doctor and then the respiratory therapist and he's just over it. After he's seen the doctor and a nurse, he's like 'I don't want to see any more people.' But the video conference was easier because we just see the doctor, everything is good, moving on."

Category 2: improving access to care

Participants saw telemedicine visits as improving their access to asthma care in several ways. First, telemedicine visits allowed parents and patients to see a specialist without having to spend significant

Table 2. Adjusted odds of telemedicine use for asthma care among demographic sub-groups during the pandemic (March 19, 2020–September 30, 2020), *N*=502.

	OR	95% CI	p-value
Age			
Young adults (18–24)	Ref	–	–
Adolescents (13–17)	0.55	0.30–1.01	0.054
School-aged (6–12)	0.43	0.24–0.77	0.005
Preschool-aged (2–5)	0.83	0.44–1.56	0.558
Urban/rural residence			
Urban	Ref	–	–
Rural	0.80	0.42–1.52	0.498
Sex			
Female	Ref	–	–
Male	0.83	0.57–1.23	0.359
Primary language			
English	Ref	–	–
Language other than English	0.12	0.025–0.54	0.006
Insurance			
Private	Ref	–	–
Public	0.77	0.47–1.24	0.280
Type of asthma care received			
Specialty care only	Ref	–	–
Primary care only	0.55	0.34–0.91	0.020
Both specialty and primary care	1.39	0.43–4.49	0.578
Distance to UC Davis Health			
≤10 miles	Ref	–	–
11–25 miles	0.73	0.44–1.22	0.264
26–50 miles	1.10	0.61–2.01	0.514
51–100 miles	0.73	0.32–1.67	0.452
>100 miles	1.44	0.64–3.27	0.377
Race/ethnicity			
White	Ref	–	–
Hispanic	0.96	0.59–1.56	0.866
Asian	0.56	0.27–1.14	0.111
Black	0.73	0.35–1.51	0.396
Other or unknown	0.76	0.44–1.31	0.327

time and expense traveling (*Theme: Traveling/living far away*). Additionally, telemedicine visits reduced the burden on parents of having to travel with young children and having to find and pay for childcare for other children (*Theme: Having young children at home*).

Parent and patient participants noted that telemedicine allowed them to have a regular work or school day, while in-person visits often require a full day off (*Theme: Limiting missed work and school time*). As one parent noted,

“She could go to school for the entire day and I didn’t have to physically take her out of school, drive to Sacramento for an appointment, and have to manage care for my younger daughter.”

Parents and patients perceived that they were able to access telemedicine visits more quickly than in-person visits for asthma care (*Theme: Having quicker access to a physician through telemedicine*). Finally, parent participants appreciated telemedicine visits as a way to protect their children and other family members from COVID-19 exposure (*Theme: Receiving care while avoiding COVID-19 exposure*). In contrast, young adult participants did not feel that this was a significant benefit of telemedicine.

Category 3: experience of visit

Parents and patients found that over time, visit experience improved as technology literacy improved for both providers and patients (*Theme: Improving technology literacy*):

“Yeah [the doctor] got better but like I said sometimes it froze and I was in the waiting room a couple times and he forgot to click me in, little things like that, but you know practice makes perfect... I think it’s moving from when it first started it was a little shaky but now I think we’re all getting there.”

In addition, parent participants found telemedicine to be beneficial because it allowed both parents to be present during the visit (*Theme: Engaging coparents in recommendations*). One parent stated:

“Sometimes it’s a little easier for the other parent to hear it from the doctor rather than it being relayed person to person. So it makes it convenient that both parents can be there as opposed to both having to travel to get there.”

Category 4: measurements

Some participants expressed concern that telemedicine visits could delay pulmonary function measurements, such as spirometry (*Theme: Concern about frequency*

Table 3. Summary of categories and themes related to use of telemedicine for asthma care identified during focus groups.

Category	Theme	Illustrative quotes	Interpretive summary
Engaging with the patient	Difficulty establishing therapeutic alliance over telemedicine	"I've done a lot of telemedicine stuff over this past year and a lot of it was extremely convenient with the doctors that I know and that I've seen over the years but meeting new doctors, I did not like that. I would rather be in person when meeting somebody new and have that one-on-one with them in person."	Parents and patients felt that telemedicine visits were more effective when with a familiar provider; telemedicine visits were more difficult with a new provider
	Concentrating visit time with the physician	"My son, there's sometimes we've seen the doctor and then the respiratory therapist and he's just over it. After he's seen the doctor and a nurse, he's like I don't want to see any more people. But the video conference was easier because we just see the doctor, everything is good, moving on."	Parents and patients saw seeing only the physician (as opposed to the entire care team) as an advantage to telemedicine.
	Physician presence facilitating receptiveness to patient counseling and education	"I prefer the in person visit because my kid knows that he has seen a doctor and he has to take this medication. Otherwise I would have to convince my kid and he would say no you're making me take this medication because you want me to do that. So it's a little bit easier to convince them because they've seen a doctor and they've told them you have to do it." "I'm all for virtual visits but at the same time it's nice to have somebody else talk to our kids and reinforce what they should be doing. Which does happen through a video visit but I think the personal aspect of just being in the same room is also just very important."	Parents felt that in-person interaction between the physician and the child was more effective for helping the child to understand the importance of medication adherence and other management strategies.
	Engaging pediatric patients as active participants	"My daughter wasn't really willing to do the telemedicine...when we're in the office she is more willing to interact and participate so for us, yeah she was kind of like ok you talk to him I'm going to go." "My son is really quiet and shy, so to be on screen and talking, it's hard for them to interact, to feel comfortable. So I think when they go into the office they get that face to face and he's more comfortable talking to the doctor when he has gone in. On the phone he's much more shy and it's harder for him to speak up if he feels something."	Parents observed that children were more actively engaged during in-person visits than telemedicine visits.
	Traveling/living far away	"I think because we live almost 3 h away that we would go in if it's really necessary. I think the telemedicine is really convenient for us but I think if we lived closer I would prefer to be in person."	Patients and parents who lived far away from the hospital perceived that telemedicine saved time and expense.
Improving access to care	Having young children at home	"One downside of going in person is the wait time to go in the room. One time we sat in the waiting room for almost 40 min and with a three year old at the time, that was a nightmare. Definitely doing Zoom was a lot easier than having to go and baby wrangle."	Parents of young children felt that telemedicine visits decreased the burden of traveling and waiting with young children and prevented the need for additional childcare
	Limiting missed work and school time	"She could go to school for the entire day and I didn't have to physically take her out of school, drive to Sacramento for an appointment, and have to manage care for my younger daughter."	Parents and patients appreciated that telemedicine allowed them to receive care without missing school or work.
	Having quicker access to a physician through telemedicine	"But I feel like it's a nice convenience even for urgent situation. Like even with those PCPs it was same day type appointments because they don't want me to bring him in the office."	Parents and patients perceived shorter wait times for telemedicine visits as compared with in-person visits.
	Receiving care while avoiding COVID-19 exposure	"So the video visits were a life saver for us, it was really nice to be able to still get the care, still have that conversation without having to venture out, especially at the beginning when we weren't sure what was happening, what we really needed to do."	Parents saw telemedicine as invaluable during the pandemic for limiting family exposure to COVID-19. Young adult patients did not share this feeling.
	Engaging coparents in recommendations	"Sometimes it's a little easier for the other parent to hear it from the doctor rather than it being relayed person to person. So it makes it convenient that both parents can be there as opposed to both having to travel to get there."	Telemedicine allowed both parents to participate in the child's visit, where usually only one parent could attend due to work and family obligations.
Experience of visit	Improving technology literacy	"Yeah [the doctor] got better but like I said sometimes it froze and I was in the waiting room a couple times and he forgot to click me in, little things like that, but you know practice makes perfect... I think it's moving from when it first started it was a little shaky but now I think we're all getting there."	Over time, telemedicine experiences became smoother as technology literacy improved during the pandemic.

(Continued)

Table 3. Continued.

Category	Theme	Illustrative quotes	Interpretive summary
Measurements Scheduling	Willingness to adopt home monitoring in conjunction with video visits	<p>"I don't want to add respiratory therapist to my resume. I'm already teacher [because of the pandemic]...I'll leave it up to the professionals. I don't need any more in my repertoire. I am full to my capacity. And I probably wouldn't do it right. There would be a huge margin for error."</p> <p>"Yeah I agree my son was the same way. He would probably not bother doing it, or play around with it, or just not get the numbers right if he wasn't being coached."</p> <p>"My two are young and growing and we need to see their growth, they need to be measured, so that's why I feel like we need to come in."</p>	While some parents and patients expressed willingness to take measurements at home, most did not feel confident in their ability to monitor effectively
	Concern about frequency of measurements	"It was a lot easier getting your appointment scheduled there. Because it was like playing phone tag after the [video] appointment and having young kids I was distracted and then a month would go by and I would be like oh we never made our appointment. So that was also a little difficult. A lot easier making it once you're there."	Some parents expressed concern that the need for more frequent measurements made telemedicine visits less useful.
	Difficulty scheduling follow-up visits after a video visit	"Because usually we walk out and we go straight to the desk to schedule. My kids see the doctor every 3 months and like I said I totally missed my appointment. But I got it this time! But I still had to call the office and they told me another time. But it's kind of like that out of sight out of mind kind of thing, we're so used to the routine of going into the office and doing what you need to do and then head to the receptions and then head out."	Parents and patients found it more difficult to schedule follow-up appointments following a telemedicine visit.
	Using video visits in conjunction with in-person visits when asthma is well controlled	<p>"To actually be able to listen to her and see her in person is beneficial from time to time. But as long as things are stable and she's not needing any changes, that going to the video visits regularly and then maybe every 6 months to a year to be able to have an in-person one to really like listen to you and check everything out. I would go that route."</p> <p>"So maybe every other visit. Like say they went in to the actual appointment, then the next three months maybe that could be a video chat because if nothing changes, everything is okay dokey. So maybe alternating it, that would work for me."</p>	Parents and patients preferred that telemedicine visits could be used in conjunction with in-person visits for asthma care; many suggested alternating visits when asthma is well controlled.
Future use of telemedicine for asthma care		"I think if my daughter wasn't doing well I would want to be in person but as long as things were progressing and doing well and it was more of a check in I think it's a really nice convenience... for a maintenance type thing- I wouldn't want it to be every appointment. I do think there needs to be a check in annually or every 6 months depending on the severity of the situation."	

of measurements). While some parents and patients stated a willingness to attempt monitoring at home (with the use of home spirometers or peak flow meters), most did not feel confident in their ability to use home monitoring equipment effectively (*Theme: Willingness to adopt home monitoring in conjunction with video visits*). One parent remarked,

“I don’t want to add respiratory therapist to my resume...I am full to my capacity. And I probably wouldn’t do it right. There would be a huge margin for error.”

Category 5: scheduling

All participants who had used telemedicine expressed that scheduling follow-up appointments was more difficult than in-person appointments, because it required additional steps after the visit (*Theme: Difficulty scheduling follow-up visits after a video visit*). As one participant remembered:

“It was a lot easier getting your appointment scheduled there. Because it was like playing phone tag after the [video] appointment and having young kids I was distracted and then a month would go by and I would be like oh we never made our appointment. So that was also a little difficult. A lot easier making it once you’re there.”

Category 6: future use of telemedicine for asthma care

Nearly all participants across the three focus groups agreed that a combination of telemedicine visits and in-person visits would be preferred when asthma is well controlled (*Theme: Using video visits in conjunction with in-person visits when asthma is well controlled*):

“To actually be able to listen to her and see her in person is beneficial from time to time. But as long as things are stable and she’s not needing any changes, that going to the video visits regularly and then maybe every 6 months to a year to be able to have an in-person one to really like listen to you and check everything out. I would go that route.”

Specifically, many participants felt that alternating in-person and telemedicine visits would be preferred to minimize burden on patients and families while still having the benefits of in-person care. One parent participant did not agree, stating that the family would not continue using telemedicine for asthma visits after the pandemic; the reason for this was the perceived need for more frequent pulmonary function tests.

Discussion

Our mixed-methods study provides important insights into the adoption, use and experience of telemedicine

for asthma care among children and young adults. First, our findings suggest that it is more difficult to establish a therapeutic alliance over telemedicine, implying that telemedicine visits with new providers should be avoided until providers have additional experience and/or training in telemedicine-based therapeutic alliance with new patients. Second, our findings suggest that engaging pediatric patients can be more difficult over telemedicine. Given this fact, providers and researchers should work to develop strategies to actively engage pediatric patients over video. Third, we found that scheduling follow-up visits is often more difficult after a telemedicine visit; incorporating follow-up scheduling into telemedicine visit workflows may prevent delays in care that could result from an inefficient scheduling system. However, it should be noted that this may not apply to all institutions. Fourth, our study demonstrates that telemedicine services can indeed make an impact on the lives of patients and parents by reducing the burden on families of travel and childcare, by reducing missed work or school, and by allowing both parents to be present during the visit. Previous studies have found similar impacts from school-based telemedicine programs (19–21); however, our study is the first to examine direct-to-home telemedicine visits for asthma care.

Our findings suggest that alternating in-person and telemedicine visits for routine asthma care is acceptable to parents of pediatric patients and to young adult patients with asthma when asthma is well controlled. Using telemedicine and in-person visits in conjunction may be an effective way to balance the improved access and convenience offered by telemedicine with the improved patient experience and measurements offered by in-person visits. Although the use of home monitoring devices such as spirometers and peak flow meters may complement telemedicine visits, our study findings indicate that there may be reluctance among many patients and parents to use these devices due to low self-efficacy and high perceived burden in this age group.

Quantitative results revealed that telemedicine use during the pandemic was significantly lower among patients with a primary language other than English. This finding agrees with previous studies that have found lower adoption of telemedicine services among non-English speakers (22–24). Efforts should be made to identify and address telemedicine access barriers to ensure that a shift toward telemedicine does not contribute to widening health disparities. For example, these strategies may include improving awareness of interpreter services over telemedicine, offering practice

telemedicine visits that include accessing interpreter services, and ensuring that guides on telemedicine use and best practices are appropriately translated. Our results also showed that patients seen in primary care were less likely to use telemedicine than those seen in specialty care. This may be because asthma care delivered by primary care providers was combined with other well-child care that required in-person visits (e.g. vaccinations, ADHD medication monitoring, growth measurements, etc.).

Our study has several limitations. First, we only examined visits during the first six months of the pandemic; it is unknown how telemedicine use may change as video visits continue to be offered. We added real-time language interpretation to our telemedicine encounters later in the pandemic, which may be a reason for low adoption among non-English speakers. Second, we did not have data on date of initial asthma diagnosis and thus were not able to exclude patients from the study who were receiving asthma care for the first time. However, while this may have resulted in a lower overall proportion of telemedicine visits, we do not believe this would have affected the results of our adjusted analysis because new patients should not have a different distribution of demographic characteristics compared to established patients. Third, we were not able to account for provider characteristics in our analyses. Because individual providers can have a significant impact on patient use and experience of telemedicine, this may have affected our results. Fourth, we were unable to include non-English speaking parents and patients in our focus group study; thus, our focus groups were unable to provide insight into our quantitative results showing that these patients have lower adoption of telemedicine. Future research exploring these barriers and ways to overcome them will be important for ensuring equity in access to telemedicine. Fifth, the qualitative component of our study only included females. This is not especially surprising considering that the majority of participants were parents and mothers are more likely than fathers to take on the responsibility of asthma management (25,26). While parent participants provided perspectives on care for both male and female children, we did not capture the patient perspective from young adult males. Lastly, our study was limited to one academic medical center in California; considering that health systems nationwide took varied approaches to providing telemedicine services, our findings may not be generalizable to all other institutions.

Conclusions/Key Findings: Our study is the first to evaluate provider-to-patient telemedicine use for

asthma care among children and young adults, and offers solutions for providers using telemedicine for pediatric asthma care. As telemedicine continues to be used for asthma and other pediatric conditions, providers and researchers should continue to explore ways in which telemedicine practices and workflows could be used to shrink health disparities, while simultaneously maximizing patient experience, quality of care, and access.


Declaration of interest

The authors report no conflict of interest.

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