

Leveraging Telemedicine to Reduce the Financial Burden of Asthma Care



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One of the most compelling arguments for telemedicine is its potential to increase health care access by making care more affordable for patients and families, including those affected by asthma. This goal is critically important in the United States, where the high cost of asthma care is associated with nonadherence to preventive care regimens and suboptimal health outcomes. In this clinical commentary review, we draw from the literature and our own research to identify opportunities for and challenges to leveraging telemedicine to reduce the financial burden of asthma care. Our interviews with 42 families affected by asthma during the COVID-19 pandemic suggest that under favorable circumstances, telemedicine can meaningfully reduce costs, including those related to transportation and missed work, while offering high-quality care. However, families also identified ways in which telemedicine can increase costs. For example, some reported reduced access to support services and material resources such as medication samples, which they relied on to manage costs. In this way, our findings underscore the need for careful care coordination and communication in telemedicine. We conclude by discussing the 4Rs, a structured communication approach designed to support cost conversations, increase care coordination, and help families reduce asthma care cost burden. © 2022 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2022;10:2536-42)

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THE PROBLEM OF ASTHMA CARE COSTS

Asthma is a serious and highly prevalent condition that can have a staggering economic toll on patients, families, and societies.¹⁻³ In the United States, the combined cost of asthma-related medical care, mortality, and absenteeism is estimated to be over \$80 billion/y.¹ Medical care is responsible for over half of this total, in which treated asthma patients use an average of almost \$3,300/y of care.¹ This average is composed of the costs of prescription medications (\$1,800), hospital- and emergency department–based care (\$810), and office visits (\$640).¹ The reasons for high asthma care costs are complex and include the pharmaceutical industry's shift from affordable generics to more expensive branded medications, including extremely high-cost biologics.⁴⁻⁷ The result is a constrained market in which patients and providers may find themselves with few, if any, low-cost options for managing asthma.

The economic burden of asthma care is especially problematic because patients and their families are increasingly exposed to medical costs through cost sharing. Over the past decade, the proportion of commercial health insurance plans with high deductibles has risen dramatically.⁸ High-deductible health plans require substantial out-of-pocket spending for care (\$1,400 or more annually for individuals and \$2,800 or more for families) before insurance coverage takes effect.⁹ Such cost sharing is concerning because research has found that out-of-pocket spending on asthma care is associated with medication nonadherence, forgone office visits, hospitalizations, and financial distress.¹⁰⁻¹⁶ Lower-income families with high-deductible health plans are especially vulnerable to these negative outcomes, because their spending on asthma care, although similar to that of higher-income families, comprises a larger proportion of their incomes.⁸ Thus, having health insurance does not necessarily translate into access to asthma care; the combination of high medical costs and increased cost sharing can create a barrier to effective and equitable care, even among those with commercial health insurance.

In addition to the direct costs described by medical expenditure studies, qualitative research suggests that the indirect opportunity costs of asthma care can be considerable. Most notably, patients and families may incur costs associated with taking time off from work and traveling to medical appointments.^{17,18} These costs can be especially burdensome for hourly workers with inflexible or unpredictable work schedules, as well as for rural residents and others who must travel greater distances to obtain care. Other examples of indirect costs include the interest charges and fees associated with taking on credit card or other consumer debt to pay for asthma care, as well as the longer-term cost of deferred savings for goals such as college or retirement.¹⁹ In a

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prior interview study, we found that families were willing to go to great lengths to afford asthma care. Some reported sacrificing even essentials such as food and housing to maintain adherence to the preventive medications they perceived as being nonnegotiable for health.²⁰ These findings suggest that the burden of asthma care costs may not always be clinically apparent to providers. Some patients and families may be able to maintain adherence to recommended care despite experiencing a high cost burden, but only by making substantial sacrifices in other areas of their lives. Taken together, quantitative and qualitative studies speak to the pressing need for interventions to help patients and families manage cost burden and maintain consistent access to asthma care.

Proponents of telemedicine have long argued that the modality holds promise for reducing the burden of medical costs, including those related to asthma, by providing at-a-distance health care delivery via a phone or other audio- or video-enabled device.^{21,22} Given the rapid and widespread adoption of telemedicine necessitated by the COVID-19 pandemic, the time is ripe for weighing the available evidence for and against this claim. In this clinical commentary review, we seek to do so from two vantage points. First, we review the research literature on telemedicine and asthma care in the United States with an eye toward understanding the implications for cost burden from the perspective of patients and families. Available studies were conducted before the pandemic and primarily focused on highly facilitated interventions based in schools and other alternative settings. Second, we present more recent data from an interview study we conducted to understand the experiences of patients and families who sought asthma care during the pandemic. Our findings offer a first glimpse into telemedicine's potential implications for cost burden in more naturalistic, unfacilitated contexts. We conclude by discussing a structured communication approach, known as the 4Rs, which we developed to support cost conversations among providers, patients, and families, including within the context of telemedicine.

TELEMEDICINE IN ASTHMA CARE BEFORE THE COVID-19 PANDEMIC

The prevalence of telemedicine use in asthma care before the COVID-19 pandemic is unknown, but it can be assumed to be low because only 13% to 15% of US primary care providers reported recent telemedicine use by 2016.²³⁻²⁵ Payers' complex and restrictive reimbursement policies and health care systems' limited infrastructure for telemedicine are frequently cited as primary reasons for low telemedicine adoption during that time.^{21,23,24} For example, some pre-pandemic policies limited telemedicine use to designated rural areas and did not allow patients to participate in telemedicine visits without facilitators or from their homes. For these reasons, pre-pandemic research on telemedicine in asthma care focused primarily on evaluating discrete interventions that relied on trained facilitators to support patients' engagement in telemedicine in settings other than their homes. The seven studies we identified through our narrative review of those published since 2012 were based in schools (four studies²⁶⁻³⁰), local clinics (one study³¹), mobile clinics (one study³²), and pharmacies (one study³³) (Table I). Across settings, we considered synchronous and asynchronous telemedicine visits that used audio- or video-enabled devices to engage off-site providers or other asthma specialists in direct patient care.

Among the four school-based studies we identified, a school nurse or other on-site health professional facilitated children's participation in telemedicine activities that ranged in intensity from as-needed consultations with remote asthma specialists to more structured programs with multiple remote medical and educational visits. The most notable study with regard to cost evaluated the School-Based Telemedicine Enhanced Asthma Management (SB-TEAM) program.^{27,28} The SB-TEAM intervention was facilitated by a clinical assistant who conducted up to three physical examinations of children with persistent asthma at their schools and transmitted findings to off-site physicians for review and subsequent remote consultation with parents. Participating children also received directly observed therapy, in which they took daily preventive medications at school.²⁷ Compared with an education-only control group, children in the intervention group experienced more symptom-free days and fewer emergency department visits and hospitalizations; parents' satisfaction with SB-TEAM was high.²⁷ Average costs per child incurred by the intervention and control groups did not differ statistically regarding the use of medical care (\$982 vs \$1594, respectively) or lost productivity for parents (\$415 vs \$492), but trended in favor of the intervention.²⁸ In the case of medical care, the study did not specifically assess out-of-pocket medical care costs borne by the family. In contrast to SB-TEAM, the remaining three school-based studies did not report data on cost burden,^{26,29,30} although one study found reduced absenteeism among students.³⁰

The three non-school based studies we identified evaluated telemedicine interventions facilitated by health professionals who met with participants in local clinics, mobile clinics, or pharmacies.³¹⁻³³ None of these studies assessed cost burden, but all evaluated some aspect of satisfaction with telemedicine. The clinic-based study found that the vast majority of parents attending visits for a child with asthma agreed that telemedicine visits were as good as in-person ones and saved them travel time.³¹ Similarly, participants of the mobile clinic-based study rated telemedicine positively in terms of saving them time and increasing access to care, although findings must be interpreted with caution because the response rate was low.³² Finally, participants in the pharmacy-based study rated their experience of telemedicine more moderately. They expressed a preference for in-person visits, although they appreciated that telemedicine reduced the time they had to take off from work.³³ In these ways, data on patient and families' experience of pre-pandemic telemedicine was limited overall, but they suggested relatively high satisfaction on measures that may be related to cost burden.

TELEMEDICINE IN ASTHMA CARE DURING THE COVID-19 PANDEMIC

Data are still emerging on the COVID-19 pandemic's impact on telemedicine use for asthma care, but the prevalence of use has likely risen dramatically, because almost 90% of primary care providers reported recent telemedicine use by early 2021.²⁵ Thus, to supplement published research in the context of asthma care, we conducted a secondary analysis of qualitative interview data we collected during the pandemic to provide a more recent perspective on the implications of telemedicine for asthma care cost burden. We pooled data from two studies. In the first study, we recruited 21 parents and other caregivers (called "parents" here) of children visiting a high-volume

TABLE I. Studies of asthma telemedicine interventions in the United States, 2012-2021

First author, year	Sample	Study design	Intervention description	Key findings	
				Health outcomes	Cost-related outcomes
Bian, 2019 ²⁹	Children aged 3-17 y with asthma diagnosis and enrolled in Medicaid in five South Carolina counties	Two-arm non-randomized study comparing children in one county with and four counties without a school-based telemedicine program	Trained school nurses facilitated as-needed virtual medical visits with off-site providers	Lower proportion of emergency department visits in intervention vs comparison counties	None reported
Brown, 2015 ³³	20 patients aged 7-77 y with asthma in rural county in North Dakota	Single-arm pre-post study based in community pharmacy	Pharmacy staff facilitated up to six virtual visits with off-site asthma educators	Increased proportion of patients with controlled asthma at 6-mo follow-up	Participants qualitatively reported preference for in-person visits, but appreciated not having to take time off from work
Crabtree-Ide, 2021 ²⁸	400 children aged 3-10 y with persistent asthma in New York school district	Two-arm randomized clinical trial comparing SB-TEAM, a school-based telemedicine intervention, with enhanced usual care	Trained staff facilitated up to three visits with off-site providers; program included supervised administration of preventive medications	None reported (see Halterman, 2018)	No statistical difference in costs related to medical care (\$982 vs \$1,594 per child) or parents' lost productivity (\$415 vs \$492 per child) in intervention vs control
Halterman, 2018 ²⁷	400 children aged 3-10 y with persistent asthma in New York State school district	Two-arm randomized clinical trial comparing SB-TEAM, a school-based telemedicine intervention, with enhanced usual care	Trained staff facilitated up to three visits with off-site providers; program included supervised administration of preventive medications	More symptom-free days and fewer emergency department visits and hospitalizations in intervention vs control	None reported (see Crabtree-Ide, 2021)
Lin, 2020 ³⁰	21 children aged 10-17 y with uncontrolled asthma in three low-income schools in Ohio	Single-arm pre-post study based in schools	Student nurse or study staff facilitated up to seven virtual medical visits with off-site providers and five self-management visits with psychologists; program included remote monitoring of medication use	No change in asthma severity in overall sample, but evidence of severity reduction in high-severity subgroup	Decrease in school absenteeism over 6-mo study period
Perry, 2018 ²⁶	393 children aged 7-14 y with asthma in 19 rural school districts in Arkansas	Two-arm cluster-randomized trial comparing school-based telemedicine intervention with usual care	Virtual visits for children (five visits), parents (two visits), and school nurses (one visit) with off-site providers and staff	No difference in symptom-free days in intervention vs control	None reported
Portnoy, 2016 ³¹	169 children in single health system in Kansas and Missouri	Two-arm nonrandomized noninferiority study comparing local, clinic-based telemedicine visits with in-person specialty care requiring more travel	Nurse or respiratory therapist facilitated up to three virtual visits with off-site providers, using a platform with digital stethoscopes and other remote monitoring capabilities	Noninferior asthma control in intervention vs comparison	Almost all intervention participants agreed that not having to travel to specialty care site was important to them
Van Houten, 2021 ³²	Children and parents attending 60 visits for asthma specialty care in Illinois	Single-arm pre-post study based in mobile clinic	Asthma providers facilitated off-site parents' attendance of child's mobile clinic-based telemedicine visit	None reported	Parents' no-show rates decreased over study period; parents reported telemedicine saved time and improved access

SB-TEAM, School-Based Telemedicine Enhanced Asthma Management .

TABLE II. Sample characteristics (n = 42)

Characteristic	n	(%)
Age, y		
18-39	28	(67)
40-64	14	(33)
Sex		
Female	38	(90)
Male	3	(7)
Other*	1	(2)
Race and ethnicity†		
Non-Hispanic White	22	(58)
Non-Hispanic Black	8	(21)
Hispanic	5	(13)
Other‡	3	(8)
US Census region		
Northeast	15	(36)
South	22	(52)
Midwest or West	5	(12)
Asthma role		
Diagnosis of asthma	21	(50)
Parent of child with diagnosis of asthma	21	(50)
Uncontrolled asthma§		
No	18	(44)
Yes	23	(56)
Health insurance type		
Private	23	(55)
Public¶	14	(33)
Uninsured	5	(12)

*Other includes nonbinary.

†Data not reported for four participants.

‡Other includes non-Hispanic Asian, non-Hispanic American Indian/Alaska Native, or mixed race.

§Assessed for person given a diagnosis using Asthma Control Test; data not reported for one participant.

||Assessed for person with a diagnosis.

¶Includes one participant reporting both public and private insurance.

pediatric asthma specialty clinic in North Carolina (Table II). Eligible parents were those who reported concern about the cost of the child's asthma care. In the second study, we recruited a primarily New England-based sample of 21 adults with asthma who had experienced job and insurance loss during the COVID-19 pandemic. In both studies, participants provided informed consent and received gift cards (of \$40 or \$50, respectively) for participation.

Investigators trained in qualitative methods interviewed participants by phone using a semistructured interview guide between April and August 2021. We analyzed transcripts of the interviews using thematic analysis to describe participants' experiences with and perceptions of telemedicine, including audio and video visits, and asthma care cost burden. We identified four themes.

Theme 1

Telemedicine offered good value under certain circumstances, with perceived advantages including reduced cost related to transportation and missed work. Participants most often described using telemedicine in the form of synchronous virtual visits offered by primary care or

asthma specialty clinics. They typically participated in these visits from their homes or other nonmedical settings without digital monitoring equipment or in-person facilitators to support remote physical examinations. Despite these limitations, some participants reported that under certain circumstances, telemedicine could offer good value for the money in terms of care quality. For example, they perceived routine follow-up visits with an established provider as an instance in which telemedicine "really shines," because they were able to accomplish the goals of the visit while saving on transportation costs and time away from work:

If my child was having the severe issues that she was having [previously]? [Then, telemedicine] would not be an option for me; [she'd] have to be seen [in person]. Now, for a follow-up or things like that? I think [telemedicine has] helped out tremendously, both with the burden of having to take off work and having to drive. ... Our follow-up appointments have been great. —Parent of a child with asthma

Participants especially appreciated these benefits when they lived in rural areas far from the clinic or had children who made travel especially challenging.

Theme 2

Disadvantages of telemedicine could outweigh advantages in other circumstances, with the potential unintended consequence of prolonging illness and related costs. Participants perceived telemedicine as offering lower value at times when physical examinations, such as lung function tests, or acute care were needed. They were also more reluctant to use telemedicine with new providers compared with those with whom they had established relationships. Under these circumstances, participants viewed telemedicine as potentially counterproductive. Despite avoiding transportation costs and missed work in the short term, they could find themselves with a prolonged illness and more substantial associated costs in the long term:

I think it's hard for my doctor to understand how bad the asthma attack is if I can't be there in person. I did have that issue last February when I got sick, [but] I couldn't go in. I needed to go in, but they just cared for me virtually. And it ended up being a very long-winded illness. —Adult with asthma

Such concerns were expressed in the often stressful and uncertain context of the pandemic, in which clinic closures and lockdowns at times made telemedicine a necessity rather than a choice.

Theme 3

Telemedicine could pose a barrier to the clinical care partners and material resources needed to manage asthma care costs. Participants reported that another way in which telemedicine could affect costs was by distancing patients from clinical care partners such as asthma educators and social workers, who helped them navigate cost challenges when they made in-person visits. Similarly, they noted that material support, such as medication samples and no-cost spacers and

The 4Rs	Promising practices	Examples
1. Raise the topic 	• Ask about costs routinely, not just when patients are openly struggling • Let patients know cost concerns are common	“Asthma medications can be really expensive, so I always like to check in about costs. What have you been paying for asthma meds? How reasonable are those costs for your family?”
2. Reassure 	Say that cost concerns: • Are something you want to talk about • Will not impact care quality • Can often be addressed	“I’m glad you told me this. It’s common for families to face unexpected costs when their insurance plans change. Our team has a lot of experience working with families to make good care more affordable. We can almost always find a way to help.”
3. Revise care plan 	Look for opportunities to safely reduce costs	• Switch to lower-cost medications in same class • Reduce test frequency (e.g., lung function tests) • Offer telemedicine visits if appropriate
4. Refer 	Use a team-based approach to extend what providers can do	Refer patients to other cost experts in your clinic or network, including: • Asthma educators • Social workers • Financial navigators • Pharmacists

FIGURE 1. The 4Rs approach to addressing asthma cost concerns.

other equipment, which they received during in-person visits was not immediately available during telemedicine visits:

The value [of telehealth] was not as good as seeing a doctor in person. ... Like, sometimes when I went to the doctor’s [in person], they would give me [medication] samples and stuff. ... And over telehealth, you get nothing. —Adult with asthma

Interestingly, one participant noted that clinic staff overcame this barrier in her case by mailing home the nebulizer equipment that her child needed. In this case, overcoming the limitations of telemedicine was possible, but only with additional care coordination.

Theme 4

Telemedicine value was contingent on transparent pricing and adequate health insurance coverage, which patients found difficult to obtain consistently during the pandemic. Participants noted that another key barrier to managing asthma care cost burden during the pandemic was the challenge of understanding how much telemedicine visits would cost them out of pocket. Several were confused and frustrated by unpredictable and rapidly changing pricing:

[The cost of telemedicine] was really sporadic. There was one appointment that didn’t even really get charged. And then I remember there being one appointment that was, like, \$300. ... So it was kind of confusing. —Adult with asthma

Although participants acknowledged that changes in telemedicine cost were understandable in the context of the pandemic, they noted that the value of telemedicine was highly dependent on the extent to which their out-of-pocket spending was at least comparable, but ideally lower than for in-person visits.

EVIDENCE SUMMARY AND IMPLICATIONS

Findings of our literature review and secondary data analysis suggest that evidence regarding telemedicine’s impact on asthma care cost burden is best understood in two phases, occurring before and during the COVID-19 pandemic. In the first, pre-pandemic phase, telemedicine was primarily evaluated within the context of highly facilitated programs based in schools and other alternative settings. Only one of the seven pre-pandemic studies we identified in our narrative review directly evaluated the potential for such programs to reduce cost burden for patients and families, and the results of that study were preliminary but promising. Findings from several additional studies in our review suggest that participants’ experiences of telemedicine were largely positive, including regarding factors such as transportation time, missed work, and school absences, which likely have implications for cost burden. In the second phase, telemedicine was widely and rapidly adopted in more traditional asthma care settings as an emergency response to the pandemic and largely without the benefit of facilitators or digital monitoring equipment. In our qualitative interview studies, participants who used telemedicine during that time most often framed their perspectives around cost burden in terms of telemedicine’s relative value, or care for the money, compared with in-person care. They reported that telemedicine could offer good value under certain circumstances, such as for follow-up care with established providers. However, they also noted potential financial drawbacks to telemedicine, such as when the limitations of virtual visits precluded necessary physical care, prolonged illness, or separated patients from support services. These assessments of value were made under the uniquely challenging circumstances of the pandemic in which using telemedicine was not always a choice and related health insurance coverage, price, and cost-sharing requirements were in flux.

Our findings suggest several considerations for guiding future research and clinical practice as telemedicine enters its third, post-pandemic phase of adoption in which it is increasingly integrated into health care delivery systems as a complement to,

rather than a replacement for, in-person asthma care. First, our research suggests that we have much to learn about the impact of telemedicine on asthma care cost burden. Studies of telemedicine in other disease areas suggest great promise for reducing certain costs, including those related to travel.³⁴⁻³⁶ However, future asthma-specific research is needed to evaluate more holistically how and for whom telemedicine reduces cost burden, with a particular focus on improving health care access and equity. Our findings indicate that such research should consider telemedicine in terms of its relative value in relation to in-person care, while being attuned to potential unintended consequences of telemedicine such as prolonged illness, reduced access to support services, and the impact of poor internet connectivity, including in rural communities. Distinguishing out-of-pocket costs from those covered by third-party payers will be important for isolating the type of cost that is most consequential to patients and families and their ability to adhere to preventive care regimens. Such evaluations will require patient-reported data on indirect costs in addition to traditional administrative data, because indirect costs may be where telemedicine has the most impact for patients and families.

Second, our findings underscore the extent to which telemedicine's continued use and value are contingent on health insurance coverage and reimbursement policies.³⁷ During the pandemic, the Centers for Medicaid and Medicare Services loosened restrictions for telemedicine and expanded reimbursement to be on par with in-person visits as part of the Coronavirus Preparedness and Response Supplemental Appropriations Act. Many states and commercial insurers enacted similar policies and waived cost-sharing for telemedicine to encourage alternatives to in-person care at the height of the pandemic. However, revoking payment parity and returning to the highly fragmented and restrictive policies in place before the pandemic could substantially curtail telemedicine's use. Thus, advocating for continued payment parity is critical. In addition, as cost-sharing waivers for telemedicine are phased out, outreach is likely needed to help patients and families use coverage for telemedicine in ways that avoid unexpected costs. We know from pre-pandemic research that many families struggle to understand and maximize their insurance benefits for in-person asthma care,³⁸ and our interviews conducted during the pandemic indicate that uncertainty about pricing and coverage for telemedicine has only added to their confusion. Telemedicine should be included as a component of insurance navigation programs, price transparency tools, and other strategies to help patients manage health care costs and reduce financial burden.

Finally, our findings highlight the critical role of communication and care coordination in realizing the potential for telemedicine to reduce asthma care cost burden. Cost burden is a difficult problem to address in clinical encounters for many reasons, including that patients and families are reluctant to bring up a potentially stigmatizing topic and that asthma providers often lack the information and time needed to navigate cost concerns effectively.^{39,40} As a first step to addressing these barriers, we have developed a framework known as the 4Rs that asthma providers can use in clinical encounters, including telemedicine visits, to structure their communication about costs (Figure 1). The 4Rs encourage providers to *raise* the topic of asthma care costs routinely, *reassure* patients and families that cost concerns are common and that conversations are welcomed, *revise* the care plan to reduce costs safely when possible, and *refer*

patients to asthma educators and other care team members for other support and resources. In addition to efforts such as these, future research should identify opportunities such as cost-related, patient-reported outcome measures or electronic medical record prompts, which can support asthma care teams in identifying and supporting patients and families who are experiencing cost-related challenges. Whether the telemedicine format is more or less conducive to these conversations compared with in-person care is an important question for further research.

Our clinical commentary review sought to evaluate the available evidence for and against telemedicine as an approach to reducing asthma care cost burden, and should be interpreted in light of several limitations. First, we primarily focused on telemedicine for synchronous or asynchronous medical visits that seek to connect patients and families with providers practicing in traditional health care settings. We acknowledge that telemedicine exists in other forms, including direct-to-consumer services, remote asthma monitoring programs, and education-only interventions, which are likely to have different implications for cost burden. Second, published research on telemedicine and asthma care cost burden is limited to a small number of studies conducted before the COVID-19 pandemic, and the generalizability of this research to post-pandemic care is unknown. Finally, our secondary data analysis offers novel insights into telemedicine use during the pandemic, but it relied on qualitative methods and a modest sample size of patients and families facing financial barriers to asthma care. This analysis prioritized patients' perspectives on health care quality and cost, which may differ from the views of other key stakeholders, including health care providers, regarding the benefits and limitations of telemedicine versus in-person care. Additional research will be needed to quantify the impact of telemedicine on asthma care costs during and after the pandemic in larger, more diverse samples of patients.

A limited body of research suggests that telemedicine offers promise for helping patients and families reduce asthma care cost burden. Future research is needed to understand how to integrate the array of available telemedicine services effectively into traditional health care delivery systems to maximize access to high-value interdisciplinary asthma care. This integration will require a concerted effort in conjunction with care coordination and optimized telemedicine reimbursement and cost-sharing policies, but it stands to make asthma care more accessible, effective, and equitable.

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