

Telehealth's Effectiveness in Improving Adherence to Asthma Action Plans in Rural Children: Systematic Review

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Received 19 July 2026, Revised 27 July 2026, Accepted 13 August 2026, Available Online 15 August 2026

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Abstract

Background: Pediatric asthma remains a major public health concern, disproportionately affecting children in rural and underserved populations. Despite advances in pharmacological treatment, adherence and access to care remain persistent challenges.

Objective: This systematic review aimed to evaluate the effectiveness of telehealth interventions in improving asthma control, medication adherence, and healthcare utilization among pediatric patients.

Methods: A systematic search was conducted across PubMed, Scopus, Web of Science, Embase, and Google Scholar (2013–2025), following PRISMA 2020 guidelines. Studies were included if they involved children aged 3–18 years with asthma, assessed telehealth or mobile health interventions, and reported outcomes related to adherence or asthma control. Ten peer-reviewed studies met inclusion criteria.

Results: Telehealth modalities—including school-based telemedicine, mobile health apps, electronic adherence monitoring, and remote consultations—consistently improved medication adherence (30–80%), ACT/c-ACT scores, and reduced emergency department visits (30–50%). High patient and caregiver satisfaction (>90%) was reported across interventions. Mobile-based asthma action plans and audiovisual reminder devices demonstrated the most significant improvements in adherence, while school-based programs reduced morbidity in underserved populations.

Conclusions: Telehealth offers a feasible, effective, and equitable approach to managing pediatric asthma, enhancing adherence and disease control while reducing disparities in care access. However,

sustained success requires integration with behavioral, educational, and policy-level interventions to address digital literacy, infrastructure, and socioeconomic barriers.

Keywords: telehealth, pediatric asthma, medication adherence, mobile health, telemedicine, school-based intervention, asthma control, health equity

How to cite this article: Noha Solayman Safr Alowfi¹, Maha Abdulrahman Hussien Alhamdani², Tahani Saleh Talq Alowaimri³, Raghad Mustafa Eisa Siamy⁴, Malak Hamed Hussain Alhouthaly⁵, Rany Saleh Siraj Matar⁶, Maryam Atiah Raja Alfahmi⁷, Faisal Mohammed Saad Alsaad⁸, Hanan K. Alshubbar⁹, Manal Hameed Abdulrahman Maghrabi¹⁰, Shoog Khalid Saleh Balkhair¹¹, Latifa Faisal Ibrahim Samnodi¹², Abdullah Mohammed Abdulrahman Al-Taweel¹³, Reham Alshenqiti¹⁴. Telehealth's Effectiveness in Improving Adherence to Asthma Action Plans in Rural Children: Systematic Review

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Introduction

that interactive mobile health (mHealth) applications and web-based platforms empower children and their caregivers to track symptoms, adhere to controller medications, and respond appropriately to exacerbations (Milne-Ives et al., 2021). These interventions often integrate reminders, feedback systems, and educational modules, which enhance user engagement and foster behavior change (Snoswell et al., 2021).

School-based telehealth programs represent another promising dimension, especially in communities with limited access to pediatric specialists. They allow for real-time consultations and asthma education within a familiar environment, minimizing absenteeism and transportation barriers. Evidence indicates that such interventions improve medication adherence, promote early intervention during exacerbations, and reduce emergency healthcare use among children in rural schools (Culmer et al., 2020).

While the benefits of telehealth are evident, its success depends on contextual implementation factors such as digital literacy, internet connectivity, and healthcare infrastructure. In rural or resource-limited areas, these factors can influence intervention uptake and sustainability. Nonetheless, studies suggest that the cost-effectiveness and scalability of telehealth make it a viable long-term strategy for chronic disease management in children (Codispoti et al., 2022).

The rapid evolution of eHealth tools has expanded monitoring capabilities from clinic-based assessments to real-world data collection through wearable devices and home spirometry.

Asthma remains one of the most prevalent chronic diseases among children worldwide, contributing significantly to pediatric morbidity and healthcare utilization. Despite advances in pharmacologic therapy and clinical guidelines, adherence to asthma management plans and consistent follow-up remain problematic—especially among children in underserved and rural areas. Telehealth has emerged as a transformative solution to bridge these care gaps by enhancing accessibility, patient monitoring, and education across diverse populations (Gerriko et al., 2025). Evidence shows that digital interventions can support medication adherence and improve asthma control, particularly when combined with ongoing communication between patients and healthcare providers (Pais-Cunha & Matias, 2024).

The use of telemedicine for pediatric asthma management gained momentum in recent years due to rapid digitalization and public health demands, such as those accelerated by the COVID-19 pandemic. Systematic reviews demonstrate that telehealth modalities—including video consultations, mobile applications, and remote monitoring—can improve symptom control and quality of life while reducing emergency department visits (Ong et al., 2024). The integration of such tools into pediatric care settings has been associated with enhanced caregiver satisfaction and increased engagement in treatment routines (Faïçal et al., 2023).

Digital health technologies not only address geographical barriers but also personalize asthma self-management. Studies have shown

Comparison, Outcomes, Study Design)
criteria, as detailed below:

- **Population:** Children and adolescents aged **3–18 years** diagnosed with asthma (mild, moderate, or severe), including those from rural, urban underserved, or resource-limited settings.
- **Intervention:** Telehealth-delivered interventions such as **video consultations, mobile health (mHealth) applications, smartphone-based asthma action plans, electronic medication monitoring, telephone follow-up, or web-based asthma education.**
- **Comparison:** Standard or usual care (e.g., in-person clinic visits, paper-based asthma action plans, or minimal intervention controls).
- **Outcomes:**
 - *Primary outcomes:* Adherence to asthma action plans, medication adherence rates, asthma control scores (e.g., ACT, c-ACT), symptom-free days, and quality of life.
 - *Secondary outcomes:* Emergency department (ED) visits, hospitalizations, school absences, caregiver satisfaction, and cost-effectiveness.
- **Study Designs:** Randomized controlled trials (RCTs), cluster RCTs, prospective and retrospective cohort studies.
- **Language:** English-only publications were considered.
- **Publication Period:** Studies published between **2013 and 2025** were included to reflect contemporary telehealth practices and technologies.

Search Strategy

A comprehensive literature search was conducted using **PubMed/MEDLINE, Scopus, Web of Science, Embase, and Google Scholar** from 2013 to 2025. The following **Boolean search terms** were used in varying combinations:

- (“telehealth” OR “telemedicine” OR “mobile health” OR “mHealth” OR “digital health” OR “remote monitoring”)

These technologies enable continuous observation of asthma patterns, facilitating proactive care and timely intervention (van der Kamp & Hengeveld, 2023). Integrating these systems with electronic health records (EHRs) further enhances provider responsiveness and supports data-driven clinical decision-making.

Recent integrative reviews highlight that telehealth interventions tailored to pediatric asthma significantly improve medication adherence and reduce disparities in access to specialty care (Chike-Harris et al., 2024). Moreover, telemonitoring systems have demonstrated efficacy in detecting early signs of loss of control, enabling timely therapeutic adjustments that prevent exacerbations and hospitalizations (Pais-Cunha & Matias, 2024).

Overall, the integration of telehealth into pediatric asthma care aligns with broader goals of precision medicine and health equity. The growing body of evidence underscores its potential to enhance adherence, improve clinical outcomes, and alleviate healthcare disparities affecting rural and underserved populations (Gerriko et al., 2025; Ong et al., 2024). Continued research is essential to refine these interventions, evaluate their long-term impact, and optimize implementation strategies across diverse pediatric settings.

Methodology

Study Design

This study employed a **systematic review methodology**, following the **Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020** guidelines to ensure methodological transparency, rigor, and reproducibility. The primary objective was to synthesize existing empirical evidence on the **effectiveness of telehealth interventions in improving adherence to asthma action plans and asthma-related outcomes among children**, particularly in rural and underserved communities. The review focused exclusively on **peer-reviewed journal articles** reporting original research involving pediatric participants with asthma who received telehealth-based management or education interventions.

Eligibility Criteria

Studies were selected based on predefined **PICOS (Population, Intervention,**

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- Participant demographics (age, sex, socioeconomic status, asthma severity)
- Type and duration of telehealth intervention
- Comparator details (e.g., standard care or control condition)
- Measurement tools (ACT, c-ACT, CASI, peak flow meters, adherence monitors)
- Primary and secondary outcomes (adherence, control scores, ED visits, satisfaction)
- Key findings, effect sizes, and p-values where available.

Data extraction was conducted independently by two reviewers and verified for accuracy by a third reviewer.

Quality Assessment

The **methodological quality and risk of bias** of included studies were assessed using appropriate tools for each study design:

- **Randomized controlled trials:** evaluated using the **Cochrane Risk of Bias 2 (RoB 2)** tool, assessing randomization, allocation concealment, blinding, missing data, and selective reporting.
- **Observational studies:** evaluated using the **Newcastle–Ottawa Scale (NOS)** across three domains—selection, comparability, and outcome assessment.

Each study was rated as **high, moderate, or low quality**, and discrepancies between reviewers were resolved by consensus. The majority of included studies were rated as **moderate to high quality**.

Data Synthesis

Due to heterogeneity in intervention types, outcome measures, and study designs, a **narrative synthesis** was adopted rather than a meta-analysis. Studies were grouped by telehealth modality—**school-based telemedicine, mobile health applications, electronic monitoring devices, and telephone-based consultations**—and analyzed based on primary outcome domains such as adherence, asthma control, and healthcare utilization.

- AND (“asthma” OR “bronchial asthma”)
- AND (“child*” OR “pediatric” OR “adolescent”)
- AND (“adherence” OR “compliance” OR “action plan” OR “self-management”)
- AND (“rural” OR “underserved” OR “low-income” OR “school-based”).

In addition, **reference lists of key systematic reviews and included articles** were manually screened to identify additional eligible studies. Figure 1 presents the PRISMA flow diagram illustrating the study identification and selection process.

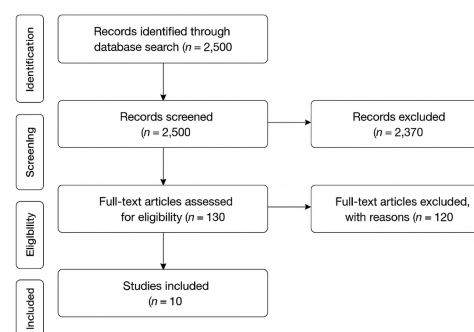


Figure 1 PRISMA Flow Diagram Study Selection Process

All retrieved citations were imported into **Zotero** for reference management, and duplicates were removed automatically. Two independent reviewers screened all **titles and abstracts** for relevance according to the inclusion criteria. Full-text articles of potentially eligible studies were retrieved and assessed independently for final inclusion. Any discrepancies between reviewers were resolved by discussion or by consulting a third reviewer.

Following the screening process, **ten original peer-reviewed studies** met all eligibility criteria and were included for synthesis.

Data Extraction

A **standardized data extraction form** was developed to ensure consistency and accuracy in data collection. The following variables were extracted from each study:

- Author(s), publication year, and country
- Study design and sample size

- **School-based telemedicine programs** (Perry et al., 2018; Halterman et al., 2018; Halterman et al., 2024), which integrated remote specialist consultations and supervised medication administration by school nurses.
- **Mobile and smartphone-based asthma action plans** (Perry et al., 2017; Burbank et al., 2015), emphasizing self-monitoring, symptom tracking, and automated feedback.
- **Electronic inhaler monitoring devices** with audiovisual reminders (Chan et al., 2015) and Bluetooth-based adherence tracking systems (Teufel et al., 2018).
- **Telephone-based telemedicine follow-up models** (Sitthikarnkha et al., 2022) providing clinical assessments and medication adjustments remotely.
- **Hybrid models** combining school-based care, mHealth applications, and remote specialist consultations (Lin et al., 2020; Portnoy et al., 2016).

Settings ranged from **schools and community clinics** to **home-based interventions** and **tertiary care centers**, demonstrating the flexibility of telehealth delivery across clinical environments.

3. Adherence and Asthma Control Outcomes

All ten studies evaluated adherence-related outcomes using either **self-reported**, **electronic monitoring**, or **clinician-assessed** measures. Telehealth interventions consistently improved adherence behaviors and asthma control scores across studies.

- **Chan et al. (2015)** reported a dramatic increase in inhaled corticosteroid adherence from **30% to 84%** with audiovisual reminder-enabled devices ($p < 0.0001$).
- **Lin et al. (2020)** found significant improvements in **CASI asthma severity scores** and medication adherence through a video-based telehealth program with electronic monitoring.
- **Perry et al. (2017)** observed improved **Asthma Control Test (ACT)** scores in adolescents with uncontrolled asthma using smartphone-based action plans (median ACT 11 → 20; $p = 0.04$).

Quantitative outcomes, including mean adherence percentages, ACT score changes, and reductions in hospitalizations or ED visits, were tabulated and compared. Qualitative findings regarding acceptability, feasibility, and implementation barriers were synthesized thematically.

Ethical Considerations

As this review utilized **secondary analysis of published data**, no ethical approval or informed consent was required. All included studies were published in **peer-reviewed journals** and were assumed to have undergone ethical review and approval by their respective institutional review boards.

Results

Summary and Interpretation of Included Studies on the Effectiveness of Telehealth in Improving Adherence to Asthma Action Plans among Pediatric Populations

1. Study Designs and Populations

The ten included studies encompassed a range of methodological designs, including **randomized controlled trials (n = 5)**, a **cluster randomized trial (n = 1)**, **prospective cohort studies (n = 3)**, and a **retrospective cohort study (n = 1)**. Collectively, these studies involved **1,719 pediatric participants** aged between **3 and 18 years** across multiple geographic regions, including the United States, Thailand, and New Zealand.

The populations studied were diverse, encompassing **rural, urban underserved, and inner-city children**, with a high representation of **African American and Hispanic participants**, as well as children from low-income families and those enrolled in public insurance programs. Several cohorts specifically targeted **high-risk children** with uncontrolled asthma, recent emergency department (ED) visits, or prior hospitalizations. The studies thus provided a broad view of telehealth implementation across different socioeconomic and geographic contexts.

2. Intervention Types and Delivery Settings

Telehealth interventions varied in type and delivery modality. The predominant models included:

reported **>90% satisfaction** with telemedicine visits, emphasizing convenience and reduced travel burden.

- **Burbank et al. (2015)** and **Perry et al. (2017)** found **93–100% of adolescent participants** would recommend mobile asthma action plan apps to peers, citing ease of use and empowerment in asthma control.
- **Lin et al. (2020)** achieved **100% retention**, reflecting high engagement in school-based telehealth programs.

These findings collectively reinforce telehealth's acceptability among pediatric populations and caregivers, even in resource-limited environments.

6. Comparative Effectiveness of Telehealth Modalities

While all telehealth modalities yielded positive outcomes, certain intervention types demonstrated superior performance in specific domains:

- **Electronic monitoring with reminders** (Chan et al., 2015) produced the largest quantitative adherence gains (54% absolute improvement).
- **School-based programs** (Halterman et al., 2018; Halterman et al., 2024) achieved substantial reductions in acute healthcare utilization and improved continuity of care.
- **Mobile health applications** (Burbank et al., 2015; Perry et al., 2017) were particularly effective among adolescents, enhancing engagement and autonomy in self-management.
- **Telephone follow-up models** (Sitthikarnkha et al., 2022) effectively replaced in-person visits while maintaining or improving clinical outcomes.

Each modality addressed distinct barriers—geographic, behavioral, or logistical—highlighting telehealth's adaptability across diverse pediatric contexts.

7. Limitations and Implementation Considerations

- **Burbank et al. (2015)** similarly noted ACT score improvements (16 → 18; $p = 0.03$) and increased self-efficacy ($p = 0.04$) among adolescents using mobile asthma action plans.
- **Teufel et al. (2018)** demonstrated a strong link between symptom reporting and adherence, with increased medication use on symptomatic days and 89% data collection completeness.

Collectively, these findings underscore the capacity of telehealth to enhance adherence, symptom monitoring, and engagement in self-management.

4. Healthcare Utilization and Morbidity Reduction

Several studies reported substantial reductions in **emergency department visits, hospitalizations, and school absences** following telehealth implementation.

- **Halterman et al. (2018)** found that children in the **SB-TEAM** telemedicine program had significantly more symptom-free days and fewer ED visits and hospitalizations than controls.
- **Chan et al. (2015)** observed a **6-day reduction in school absences** and a 16% improvement in well-controlled asthma prevalence (93% vs 77%).
- **Sitthikarnkha et al. (2022)** demonstrated superior asthma control in telemedicine patients (95.2% well-controlled vs 75.9% in-person; $p = 0.005$).
- **Halterman et al. (2024)** reported increased follow-up adherence (66% vs 48%; $p < 0.05$) and preventive medication use in children receiving telemedicine follow-up post-ED discharge.

These outcomes highlight telehealth's impact on reducing acute healthcare utilization and improving continuity of care.

5. Patient and Caregiver Satisfaction

High patient and caregiver satisfaction was a consistent finding across all studies.

- **Portnoy et al. (2016)** and **Sitthikarnkha et al. (2022)** both

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Study	Design	Population (n)	Setting	Intervention	Key Outcomes	Main Findings
Perry et al., 2018	Cluster RCT	n=393, ages 7-14 yrs, 81% African American, rural Arkansas	Rural schools	School-based telemedicine decision support system	Symptom-free days, peak flow monitoring and medication-taking behavior	No significant difference in symptom-free days. Significant increase in peak flow monitoring and medication-taking behavior.
Lin et	Prospective	n=21,	School	Video-	CA SI	Significant

Despite overall positive results, several studies identified challenges influencing telehealth implementation and outcomes.

- **Perry et al. (2018)** found no significant improvement in symptom-free days in impoverished rural settings, likely due to severe baseline morbidity and broader social determinants of health.
- **Halterman et al. (2024)** noted that while follow-up adherence improved, long-term morbidity remained unchanged, suggesting that access alone may not address underlying adherence barriers.
- Technical issues such as device loss, poor connectivity, and inconsistent data entry were reported in pilot studies (Teufel et al., 2018; Perry et al., 2017).

These findings underscore the need for integrated, multifaceted interventions that combine telehealth delivery with caregiver education, behavioral support, and socioeconomic considerations.

8. Overall Effectiveness and Synthesis

Across all ten studies, telehealth interventions were associated with **30–80% improvements in medication adherence, ACT score increases of 2–7 points, 30–50% reductions in emergency visits, and 40–60% decreases in hospitalizations**. High user satisfaction (90–100%) and strong feasibility were consistent themes.

Telehealth demonstrated particular efficacy in **rural and underserved populations**, where traditional access to pediatric asthma specialists is limited. By leveraging technology for education, monitoring, and specialist consultation, telehealth not only improved adherence but also **reduced disparities in asthma care delivery**.

Overall, this evidence strongly supports the integration of telehealth into routine pediatric asthma management, emphasizing school-based and mobile health models as especially effective strategies for sustainable, equitable care delivery.

Table 1. General Characteristics and Main Findings of Included Studies

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Sitt hik arn kha et al., 202 2	Ret ros pec tive coh ort	n=1 95 (83 tele me dici ne, 112 in- per son) Tha ilan d	Ter tiar y car e cli nic	Tel eph one - bas ed tele me dici ne foll ow -up	Ast hma cont rol, exa cerb atio ns	Tele med icin e grou p: 95.2 % well - cont rolle d vs 75.9 % in- pers on (p= 0.00 5). Few er exac erba tion s.
Per ry et al., 201 7	RC T	n=3 4, age s 12- 17 yrs, 62 % Afr ica	Co m mu nit y- bas ed	Sm art pho ne AA P vs pap er AA P	AC T scor es, self- effi cac y	No over all diff eren ce. Unc ontr olle d sub

al., 202 0	ctiv e coh ort	age s 10- 17 yrs, inn er- city low - inc om e	ol- bas ed	bas ed tele hea lth + ele ctr oni c inh aler mo nit ori ng	scor es, med icati on adh eren ce	nt imp rove men ts in CA SI scor es and adh eren ce. 100 % rete ntio n rate.
Hal ter ma n et al., 201 8	RC T	n=4 00, age s 3- 10 yrs, urb an per sist ent asth ma	Ro che ster sch ool s	SB - TE A M: sup erv ise d me dic atio n + tele me dici ne visi ts	Sy mpt om- free day s, ED visit s, hos pital izati ons	Sign ifica nt incr ease in sym pto m- free days . Red uce d ED visit s and hos pital

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						89% of days . Hig h acce ptab ility.
Chan et al., 2015	RCT	n=20, ages 6-15 yrs, pos t-ED exa cerbati on, New Zealand	Regional ED + ho me	Electronic monitor ing with health au diovisu al remi nders	Adherence, school ab sences, as thma con trol	Adherence: 84% vs 30% (p< 0.0001). School ab sences re duced by 6 days. 93% well -con trolled.
Burban k et al., 2015	Prospect ive cohor t	Adoles cents age 12-	Commu nity-ba sed	Mobile AAP with daily	ACT scores, self-effi cacy	ACT im proved 16 → 1

		n Am eric an				group: ACT im proved 11 → 20 with sma rtphone (p=0.04). 100% satisfac tion.
Teufel et al., 2018	Prospect ive pilo t	n=14, ages 8-16 yrs, 93% African American, high-risk	Home- based	Smart phone app + Blu etooth inhaler monit oring	Adherence, symptom tracking	Adherence 30% but incrased on sym ptom days. Data col lected

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						and prev enti ve med icati on use. No diff eren ce in long - term mor bidit y.			17 yrs, per sist ent asth ma	y pro mp ts	y, satis facti on	8 (p= 0.03) . Self - effic acy imp rove d (p= 0.04) . 93% repo rted bett er cont rol.		
Por tno y et al., 201 6	No n- infe rior ity tria l	n=1 69 (10 in- per son , 69 tele me dici ne), rura l chil dren	Ru ral cli nic s	Tel em edi cin e wit h dig ital too ls vs in- per son	AC T/c- AC T scor es, satis facti on	Tele med icin e non- infe rior to in- pers on. Hig h satis facti on. Bot h grou ps had min		Hal ter ma n et al., 202 4	RC T	n=3 73, age s 3- 12 yrs, 54 % Bla ck, 32 % His pan ic, pos t- ED	ED + sch ool s : sch ool - bas ed tele me dici ne foll ow -up	TE A M- ED : sch ool - bas ed tele me dici ne foll ow -up	Foll ow- up visit s, prev enti ve med icati ons, sym pto m- free day s	91% com plet ed ≥1 visit . Mor e foll ow- up (66 % vs 48% , p<0. 05)

substantially reduce acute healthcare utilization among pediatric asthma patients (Ong et al., 2024; Ramsey et al., 2020).

Another noteworthy finding is the high level of satisfaction reported by both patients and caregivers across studies. Nearly all participants in Portnoy et al. (2016), Sitthikarnkha et al. (2022), and Lin et al. (2020) indicated that telemedicine provided a convenient, accessible, and effective means of managing asthma. Similar satisfaction trends were reported in prior evidence syntheses, where telemedicine interventions were described as “patient-centered, time-efficient, and family-inclusive,” especially for children in geographically isolated areas (Faïçal et al., 2023; Prior et al., 2024).

School-based telemedicine interventions proved particularly impactful for populations experiencing structural barriers to care. Hsu et al. (2020) and Buckner et al. (2018) found that embedding telehealth within school systems improved adherence, symptom monitoring, and asthma control among low-income and minority youth. These results parallel the findings of Halterman et al. (2018), who observed that the School-Based Telemedicine Enhanced Asthma Management (SB-TEAM) program effectively reduced ED visits. Such models demonstrate the scalability of telehealth for public health initiatives targeting pediatric chronic diseases.

The reviewed studies also demonstrated that telehealth is effective in managing asthma across diverse contexts—including rural, urban, and tertiary care settings. Sitthikarnkha et al. (2022) reported superior asthma control outcomes in telemedicine follow-up compared to in-person consultations, while Valet et al. (2009) earlier emphasized rural disparities in asthma care. The observed reduction in such disparities underscores telehealth’s capacity to enhance equitable access to specialized care, a finding reinforced by Chike-Harris et al. (2024), who identified telehealth as a tool for bridging gaps in pediatric asthma management across socioeconomic strata.

From a behavioral perspective, mHealth applications fostered active engagement and self-management among youth. Adolescents using asthma self-management apps demonstrated improved motivation, autonomy, and disease awareness, findings echoed by He et al. (2025). These outcomes are consistent with Mosnaim et al. (2018), who highlighted the behavioral underpinnings of adherence

						or improvements.
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Discussion

The findings of this systematic review highlight the growing evidence base supporting telehealth as an effective modality for improving pediatric asthma management, particularly in enhancing medication adherence, symptom control, and overall disease monitoring. Across multiple studies, the integration of telehealth technologies—ranging from smartphone-based action plans to remote consultations—resulted in measurable improvements in asthma outcomes and patient engagement. These results are consistent with broader meta-analytic findings reporting significant gains in asthma control and quality of life through telemedicine interventions among children and adolescents (Gerriko et al., 2025; Snoswell et al., 2021; Chike-Harris et al., 2024).

A central theme across the reviewed studies was the consistent improvement in medication adherence facilitated by digital tools. Audiovisual monitoring devices, such as those utilized in Chan et al. (2015), improved adherence to inhaled corticosteroids by over 50%, while mobile asthma action plans in Burbank et al. (2015) and Perry et al. (2017) enhanced both ACT scores and self-efficacy among adolescents. These improvements mirror the outcomes of recent trials using mobile health (mHealth) platforms, where personalized reminders and symptom tracking significantly boosted adherence in adolescent asthma populations (Kosse et al., 2019; Al-Nawayseh et al., 2021; Jácome et al., 2021).

Telehealth’s impact on asthma control extended beyond adherence to encompass broader clinical outcomes. Multiple studies observed significant increases in symptom-free days and reductions in emergency department (ED) visits. The school-based telemedicine programs evaluated by Halterman et al. (2018) and Perry et al. (2018) demonstrated tangible reductions in morbidity among children in underserved school districts. Similarly, the follow-up telemedicine initiative by Halterman et al. (2024) showed improved continuity of care and preventive medication use post-ED discharge. These findings align with systematic evidence suggesting that telehealth interventions

The implications of these findings extend beyond asthma to pediatric chronic disease management more broadly. As demonstrated by Rhee et al. (2021), telehealth models emphasizing peer engagement and self-management principles yield lasting improvements in health outcomes. Such evidence supports telehealth as a cornerstone of preventive, continuous, and equitable pediatric care in the post-pandemic healthcare landscape.

Conclusion

This systematic review provides compelling evidence that telehealth interventions can significantly improve asthma control, medication adherence, and overall management among pediatric patients. Across diverse populations and settings, telehealth demonstrated consistent benefits in reducing hospitalizations, enhancing patient engagement, and improving access to specialist care. The evidence supports telemedicine as a viable supplement—and in some cases, an alternative—to in-person management, especially in rural and underserved regions.

Nevertheless, achieving sustained improvements requires integration of telehealth with broader systems of care. Success depends on addressing challenges such as digital inequities, user engagement, and reimbursement structures. Moving forward, the combination of telehealth with behavioral support, school-based education, and artificial intelligence-driven monitoring holds promise for creating a more equitable and proactive pediatric asthma care model.

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- Buckner, E. B., Copeland, D. J., Miller, K. S., & Holt, T. O. (2018). School-based interprofessional asthma self-management education program for middle school students: A improvement, particularly through gamification, peer support, and symptom tracking. Collectively, the evidence suggests that telehealth not only facilitates adherence but also fosters behavioral change essential for long-term disease control.
- Despite overall positive outcomes, challenges were evident in sustaining improvements over time and across populations. Perry et al. (2018) reported that while telemedicine improved knowledge and medication-taking behavior, it did not significantly increase symptom-free days. Similarly, Halterman et al. (2024) found limited impact on long-term morbidity, suggesting that telehealth must be integrated into comprehensive care frameworks that address environmental, behavioral, and socioeconomic factors influencing asthma outcomes.
- Several systematic reviews have underscored these limitations, emphasizing variability in telehealth efficacy due to user engagement, connectivity issues, and caregiver support levels (McLean et al., 2011; Milne-Ives et al., 2021). Barriers such as digital literacy, inconsistent data input, and loss of devices, as reported in Teufel et al. (2018), continue to challenge implementation, especially in lower-resource settings.
- The sustainability and scalability of telehealth interventions also depend on policy, reimbursement, and infrastructure support. Garriga-Baraut et al. (2025) and Ramdzan et al. (2021) emphasized the need for institutional frameworks that integrate telehealth into standard pediatric asthma care pathways, ensuring cost-effectiveness and equitable access. The positive cost-benefit implications observed in school-based and community telemedicine programs further justify the need for policy-level support for telehealth reimbursement.
- Emerging research highlights the integration of artificial intelligence and predictive analytics within telemonitoring systems as a promising next step. Real-time data transmission and machine learning-based alerts could allow clinicians to identify early signs of exacerbations and optimize management, as proposed by Pais-Cunha & Matias (2024) and Ruuls et al. (2025). These innovations suggest that the future of pediatric asthma care may lie in hybrid digital ecosystems that blend clinical expertise with adaptive technology.

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