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The Pediatric Asthma "Coach" Model in Primary Care: A Narrative Review of Interdisciplinary Clinical, Educational, and Environmental Support

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Abstract

Background: Pediatric asthma remains a leading cause of emergency department visits, hospitalizations, and missed school days, often due to suboptimal management rooted in poor inhaler technique, inadequate education, and uncontrolled environmental triggers. Traditional, physician-centric primary care models may lack the time and specialized expertise to address these multifactorial challenges comprehensively. **Aim:** This narrative review examines the evidence for interdisciplinary "coach" models within Family Medicine that integrate nursing, respiratory therapy, and physician expertise to improve pediatric asthma outcomes. **Methods:** A comprehensive search of PubMed, CINAHL, Scopus, and ERIC (2010-2024) was conducted, synthesizing literature on asthma education, interdisciplinary care, and environmental interventions in primary care. **Results:** Evidence indicates that structured models where nurses provide core education and action plan management, respiratory therapists deliver advanced technique training and environmental assessments, and family physicians focus on medication prescription guided by team feedback, significantly improve clinical outcomes. These models enhance inhaler technique, asthma control, and quality of life while reducing acute healthcare utilization and school absenteeism. **Conclusion:** The pediatric asthma coach model represents an effective, patient-centered paradigm for primary care. Successful implementation requires redefining professional roles, securing sustainable funding, and fostering a culture of team-based chronic disease management.

Keywords: pediatric asthma; interdisciplinary team; asthma education; respiratory therapy; primary care

Introduction

Asthma is the most prevalent chronic disease in childhood, affecting millions of children worldwide and imposing a substantial burden on patients, families, and healthcare systems (Ferrante et al., 2022). Despite the availability of effective controller medications, suboptimal asthma control remains widespread, leading to preventable suffering, emergency department (ED) visits, hospitalizations, and significant school absenteeism (Fasola et al., 2022). The root causes of this "preventable burden" are often not pharmacological but behavioral, educational, and environmental: incorrect inhaler technique, poor adherence to treatment plans, inadequate recognition of warning signs, and exposure to allergens and irritants in the home and community (Kowatsch et al., 2021).

The traditional model of asthma management in primary care, centered on brief, episodic visits with a Family Physician, is ill-equipped to address this complexity. A 15-minute appointment allows little time for in-depth education, hands-on technique assessment, or exploration of the home environment (Pinnock et al., 2023). This gap between the prescription of evidence-based medication and the patient's ability to implement the treatment plan effectively is a critical failure point. Consequently, there is a growing recognition of the

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need for innovative, team-based care models that extend the capacity of the primary care practice.

This review examines the Pediatric Asthma "Coach" Model, an interdisciplinary framework designed to bridge this gap by integrating the distinct yet complementary skills of nursing, respiratory therapy, and family medicine within the primary care setting. In this model, healthcare professionals act as collaborative "coaches," providing continuous, proactive support beyond the prescription pad. The Nurse serves as the foundational educator and care coordinator, managing asthma action plans and providing core self-management training. The Respiratory Therapist (RT), with specialized expertise in pulmonary therapeutics, delivers advanced, hands-on training in inhaler and spacer technique, reviews symptom diaries for patterns, and may conduct home environmental assessments to identify and mitigate triggers. The Family Physician retains responsibility for diagnosis, medical management, and prescription, but does so with richer, more nuanced data and feedback from the coaching team.

The aim of this narrative review is to synthesize the literature from 2010 to 2024 on the structure, processes, and outcomes of such interdisciplinary coach models for pediatric asthma in primary care. It will evaluate the evidence for their impact on critical outcomes: improved asthma control test (ACT) scores, reduced exacerbations and healthcare utilization (ED visits, hospitalizations), decreased school absenteeism, and enhanced family knowledge and quality of life. Furthermore, it will analyze the practical considerations for implementation, including role delineation, reimbursement, training, and the integration of environmental interventions. By doing so, this review argues that the coach model is not merely an additive service but a necessary re-engineering of primary care delivery to effectively manage a complex, behavior-dependent chronic condition.

Methodology

This narrative review employed a systematic search strategy across healthcare and education databases. PubMed, CINAHL, Scopus, and ERIC (Education Resources Information Center) were queried for English-language articles published between January 2010 and December 2024. The search strategy combined MeSH terms and keywords across four conceptual clusters: (1) Population & Condition: "Asthma," "Child," "Pediatrics"; (2) Intervention & Model: "Patient Care Team," "Allied Health Personnel," "Nurses," "Respiratory Therapy," "Primary Health Care," "Disease Management"; (3) Intervention Components: "Patient Education as Topic," "Medication Adherence," "Inhalation Spacers," "Environmental Exposure"; (4) Outcomes: "Emergency Service, Hospital," "School Absenteeism," "Quality of Life," "Asthma/therapy." Boolean operators (AND, OR) were used to combine clusters (e.g., "Asthma" AND "Primary Health Care" AND "Patient Care Team").

Inclusion criteria were: peer-reviewed articles reporting on interventions for pediatric asthma management in primary care or outpatient settings that involved a defined interdisciplinary team including at least a physician and one other provider (nurse, respiratory therapist, health educator); studies with quantitative or qualitative outcomes related to clinical control, healthcare use, education, or self-management; and systematic reviews or meta-analyses on team-based asthma care. Exclusion criteria included: studies conducted solely in emergency or inpatient settings, programs involving only a single provider type (e.g., physician-only or nurse-only), and protocols without reported results. The initial search yielded 572 articles. After deduplication and title/abstract screening, 91 full-text articles were assessed for eligibility, with 42 selected for in-depth synthesis. Data were extracted thematically into categories of model design, professional roles, intervention components, reported outcomes, and implementation barriers/facilitators.

The Burden of Suboptimal Management and the Case for Team-Based Care

Pediatric asthma exerts a multidimensional burden. Clinically, uncontrolled asthma is characterized by persistent symptoms, nocturnal awakenings, activity limitation, and recurrent exacerbations. These exacerbations drive high rates of acute care utilization; asthma remains a top reason for pediatric ED visits and hospitalizations, many of which are potentially avoidable with optimal ambulatory management (Zahran et al., 2018). The societal and educational impact is equally profound, as asthma is a leading cause of chronic school absenteeism, disrupting academic performance and social development (Sideridis & Alamri, 2023). For families, managing a child's asthma is a source of significant anxiety, sleep disruption, and financial strain.

The failure to achieve control is rarely due to a lack of effective medications but to deficits in the delivery system. Key modifiable factors include: 1) Poor Inhaler Technique: Studies consistently show that 50-80% of patients use pressurized metered-dose inhalers (pMDIs) incorrectly, drastically reducing lung deposition and drug efficacy (Sanchis et al., 2016). 2) Limited Self-Management Education: Families often lack a clear understanding of the difference between controller and reliever medications, the purpose of an asthma action plan, and how to recognize early signs of deterioration (Ancheta et al., 2023). 3) Unaddressed Environmental Triggers: Exposure to allergens (e.g., dust mites, pet dander, cockroach, mold) and irritants (e.g., tobacco smoke, air pollution) in the home is a major contributor to symptom persistence and exacerbations (Ahluwalia & Matsui, 2011). The traditional primary care visit lacks the time, and often

the specific expertise, to systematically address these pillars of asthma management, creating a compelling rationale for a distributed, skill-based team approach.

Core Components of the Asthma Coach Model

The pediatric asthma coach model is fundamentally defined by a structured, proactive, and longitudinal approach to care, in which clinical responsibilities are strategically distributed according to the distinct expertise of each professional discipline (Vanaj, 2023). This model transcends the traditional, sequential referral system, aiming instead for true integration, with team members operating under shared clinical protocols and maintaining regular, structured communication to create a cohesive support system for the child and family (McClure et al., 2020). The effectiveness of this framework hinges on the complementary and well-defined roles of nursing, respiratory therapy, and family medicine.

Within this integrated team, the **nurse** functions as the foundational educator and the central point for continuity of care. Acting as the primary coordinator, the nurse is responsible for conducting initial and ongoing **asthma education** that is carefully tailored to the family's health literacy level, ensuring comprehension and engagement. A critical duty is the collaborative development, explanation, and regular updating of the **personalized written asthma action plan** with both the family and the physician. The nurse also performs routine, standardized **asthma control assessments**, such as administering the Asthma Control Test (ACT) or Childhood-ACT, and provides essential, baseline **inhaler technique instruction** (Chew et al., 2020). Beyond these clinical tasks, the nurse's role in **care coordination** is vital; they facilitate communication between the family, the respiratory therapist, and the family physician, and ensure timely follow-up. This relationship-based, continuous engagement is indispensable for building the trust necessary for successful long-term disease management.

The **respiratory therapist (RT)** contributes a depth of technical and environmental proficiency that is often outside the standard scope of primary care nursing and physician training. Their specialized expertise is delivered through several key interventions. First, they provide **advanced, device-specific training**, offering meticulous, repetitive, and validated instruction on the correct use of all inhaler devices—including pressurized metered-dose inhalers (pMDIs) with spacers, dry powder inhalers, and nebulizers—utilizing teach-back methodologies and device-specific checklists to ensure mastery (Lugogo et al., 2022). Second, RTs engage in **symptom pattern analysis**, reviewing patient-maintained symptom and peak flow diaries with families to identify trends, potential triggers, and early warning signs of deteriorating control. Third, and most distinctively, RTs can conduct **home environmental assessments**, sometimes in partnership with community health workers, to identify and mitigate exposure to common asthma triggers such as dust mites, mold, pests, and secondhand smoke (Pappalardo et al., 2022). They then provide families with tailored, practical mitigation strategies, such as recommending mattress and pillow encasements, HEPA air filters, or integrated pest management. This direct linkage of clinical symptoms to the home environment represents a uniquely powerful and often underutilized component of comprehensive asthma care.

The role of the **family physician** evolves and is enhanced within the coach model. By leveraging the detailed assessments, education, and environmental data provided by the nurse and respiratory therapist, the physician can optimize clinic visit time for higher-order cognitive tasks (Cheng et al., 2022). These include confirming the asthma diagnosis and phenotype, **prescribing and titrating controller medications** based on objective control metrics and direct team feedback, and managing relevant comorbid conditions such as allergic rhinitis or obesity (McTague et al., 2022). The physician serves as the diagnostic and therapeutic leader, overseeing the overall medical plan, interpreting the aggregated data collected by the coaching team, and making final therapeutic decisions. This collaborative structure allows the physician to practice at the top of their license, ensuring medical governance while benefiting from a richer, more nuanced understanding of the patient's condition and home context, leading to more informed and effective prescribing (Table 1). Figure 1 illustrates the Pediatric Asthma "Coach" Model, highlighting the coordinated roles of the family physician, nurse, and respiratory therapist in primary care.

Table 1: Roles and Responsibilities in the Pediatric Asthma Coach Model

Team Member	Core Responsibilities	Key Interventions & Skills	Outcome Goals of Their Role
Family Physician	Medical diagnosis & phenotyping; medication prescription & adjustment; management of comorbidities; overall care plan oversight.	Physical exam; spirometry interpretation; medication titration based on team data; complex case decision-making.	Accurate diagnosis; optimal pharmacotherapy; reduced need for specialist referral.
Nurse (RN/NP)	Asthma education & health literacy adaptation; asthma	Teach-back education; ACT/c-ACT administration;	Improved family knowledge & self-

	action plan co-development & management; routine control monitoring (ACT); basic inhaler training; care coordination & continuity.	development of written action plans; follow-up phone calls/visits; liaison between family and team.	efficacy; consistent use of action plans; early identification of worsening control.
Respiratory Therapist (RT)	Advanced, device-specific inhaler/spacer technique training; symptom/peak flow diary review & interpretation; home environmental assessment & trigger mitigation counseling.	Hands-on device training with placebo inhalers; environmental trigger identification; practical mitigation strategy education (e.g., HEPA filters, allergen avoidance).	Mastery of correct inhaler technique; identification & reduction of environmental triggers; objective tracking of symptoms.
Patient/Family	Active participation in education sessions; consistent use of medications as prescribed; implementation of environmental control measures; accurate symptom reporting.	Attendance at coaching visits; use of action plan; adherence to medication and environmental recommendations; communication with team.	Improved daily symptom control; reduced exacerbations; increased autonomy in asthma management.

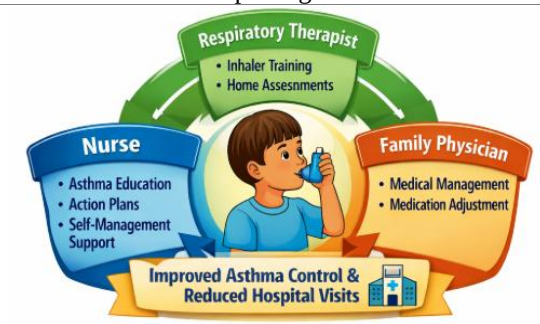

Figure 1. The Interdisciplinary Pediatric Asthma "Coach" Model in Primary Care

Reported Outcomes and Efficacy of the Model

A robust and growing body of evidence substantiates the clinical and economic efficacy of interdisciplinary pediatric asthma coach models within primary care settings (Tzeng et al., 2018). Systematic reviews of structured asthma education programs consistently conclude that interventions delivered by a combination of educators—including nurses, respiratory therapists, and health educators—produce superior outcomes compared to those delivered by physicians alone, underscoring the additive value of a team-based approach (Belice & Becker, 2016). The impact of these models is measurable across multiple, critical domains of child health and healthcare system performance. Regarding **clinical outcomes**, studies demonstrate statistically significant improvements in standardized Asthma Control Test (ACT) or Childhood-ACT scores, along with meaningful reductions in both daytime and nocturnal symptom frequency and severity (Chew et al., 2020). A pivotal mediator of this clinical improvement is the mastery of **inhaler technique**; interventions featuring dedicated, hands-on training led by respiratory therapists show marked and sustained improvements in technique scores, which correlate directly with enhanced lung function parameters and superior daily symptom control (Laube et al., 2011). This technical proficiency reduces reliance on rescue medication, as evidenced by significant decreases in the use of short-acting beta-agonists (SABA) among participants in coaching programs.

From a systems perspective, the reduction of **healthcare utilization** is a primary endpoint. Interdisciplinary coach models have been consistently associated with statistically significant reductions in asthma-related emergency department visits and hospitalizations, translating to substantial cost savings and reduced system strain (Tony et al., 2022; Rylance et al., 2021). For instance, a prominent community-based program integrating the skills of community health workers and nurses demonstrated a dramatic 60% reduction in asthma-related ED visits among enrolled children, highlighting the potent impact of combined education and environmental support (Bruzzese et al., 2009). Beyond acute care, these models yield important **functional and quality of life outcomes (**Adams et al., 2022). A consistent finding is a reduction in **school absenteeism**, as better-controlled asthma minimizes illness-related disruptions, thereby supporting academic continuity and social development (Moonie et al., 2008). Furthermore, participation in coaching programs improves asthma-specific quality of life for both children and their primary caregivers, alleviating the pervasive anxiety and burden associated with managing a chronic condition (Kew et al., 2017). Finally, while measured less frequently, programs that incorporate a direct **environmental impact** component—such as home assessments conducted by respiratory therapists or community health workers—document measurable reductions in specific allergen levels (e.g., dust mite, cockroach) and, crucially, subsequent reductions in asthma symptoms and medication use directly linked to those mitigated triggers (Phipatanakul et al., 2017).

Implementation Considerations and Challenges

Despite compelling evidence of efficacy, translating the interdisciplinary coach model from research into sustainable, widespread practice necessitates navigating significant structural, financial, and cultural barriers within primary care ecosystems. A foundational challenge is **workflow integration and role clarity**. The model demands a fundamental shift from sequential, referral-based care to integrated, concurrent teamwork. This requires the development of clear clinical protocols that define triggers for respiratory therapist involvement, establish efficient information-sharing pathways (such as shared electronic health record templates or structured team huddles), and explicitly outline the nurse's role in triaging and coordinating care; without this deliberate design, the model risks devolving into a fragmented and inefficient process (Ferrante & La Grutta, 2018). The foremost and most persistent barrier, however, is **financing and reimbursement**. Traditional fee-for-service payment models inadequately compensate for the time-intensive, non-procedural educational counseling and environmental assessments provided by nurses and respiratory therapists. Consequently, sustainable implementation often depends on securing alternative financing through value-based payment arrangements, per-member-per-month (PMPM) care management fees, or time-limited grant funding (Meyers et al., 2019). Demonstrating a clear return on investment (ROI) through analytics linking program participation to reduced high-cost acute care utilization is therefore a critical strategy for convincing payers and health system administrators (Dehmer et al., 2016).

Successful implementation also hinges on addressing **training and competency** gaps. Not all nurses or respiratory therapists possess innate expertise in pediatric asthma coaching, motivational interviewing, or environmental trigger mitigation. Programs that achieve sustained outcomes typically invest in standardized, evidence-based training curricula for all team members to ensure consistency in messaging, skill delivery, and adherence to clinical guidelines (Liu et al., 2022). Finally, to fulfill its promise, the model must be **designed with health equity and access at its core**. This requires ensuring the cultural and linguistic competency of coaching staff, proactively addressing transportation and scheduling barriers through hybrid or telehealth-enabled service delivery, and actively targeting outreach and enrollment to the highest-risk populations—such as children from low-income households or marginalized communities—who stand to gain the most benefit from intensive, supportive management (Perez & Coutinho, 2021). Table 2 summarizes the evidence synthesis for coach model components and outcomes. Figure 2 summarizes major environmental triggers associated with poor asthma control in children, including dust mites, pollen, air pollution, pet dander, indoor allergens (such as mold and damp housing), smoke, strong odors, and chemical irritants.

Table 2: Evidence Synthesis for Coach Model Components and Outcomes

Model Component	Key Supporting Studies & Findings	Magnitude of Effect	Implementation Facilitators
Structured Nurse-Led Education & Action Plans	RCTs show nurse-led self-management education improves ACT scores, reduces symptoms, and increases action plan possession (Chew et al., 2020; Bruzzese et al., 2009).	Moderate to large effect on knowledge and self-efficacy; associated with 20-40% reduction in exacerbations.	Use of standardized, culturally adapted educational materials; integration of education into every visit; teach-back method.
Respiratory Therapist-Led Device Training	Systematic reviews confirm RT or pharmacist-led training significantly improves inhaler technique vs. usual care (Sanchis et al., 2016; Laube et al., 2011).	Large, sustained improvement in technique (correct steps increase from ~30% to >80%). Direct correlation with improved FEV1 and symptom control.	Use of placebo devices for practice; checklists for each device type; reassessment at every follow-up visit.
Home Environmental Assessment & Intervention	Community health worker/RT home visits reduce allergen levels (dust mite, cockroach, rodent) and improve asthma outcomes (Phipatanakul et al., 2017; Bruzzese et al., 2009).	Reductions in relevant allergen levels by 50-80%; associated with decreased symptoms, medication use, and urgent care visits.	Partnership with local housing or public health agencies; provision of low-cost supplies (encasements, HEPA filters); tailored, practical advice.
Integrated Interdisciplinary Care	Programs with defined team roles (MD, RN, RT/CHW) show greater reductions in ED visits/hospitalizations than single-	30-60% reduction in asthma-related acute care utilization compared to control	Co-location of team members; regular team huddles; shared EHR documentation templates

	discipline interventions (Rylance et al., 2021; Liu et al., 2022).	groups.	and goals.
Telehealth Integration	Studies show telehealth follow-ups with nurses/RTs for education and monitoring are non-inferior to in-person visits for maintaining control and are associated with high satisfaction (Kichloo et al., 2020).	Effective for sustaining outcomes; improves access and reduces no-show rates, particularly for rural or transportation-burdened families.	User-friendly platform; ability to visually assess inhaler technique via video; secure messaging for questions.

Figure 2. Common Environmental Triggers of Pediatric Asthma

Future Directions and Conclusion

The pediatric asthma coach model in primary care represents a powerful evolution from a reactive, medication-focused approach to a proactive, holistic, and empowering one. By leveraging the distinct skills of nursing, respiratory therapy, and family medicine, it addresses the core behavioral, educational, and environmental drivers of poor asthma control that are often missed in traditional care. The evidence is compelling: these models improve clinical outcomes, reduce costly acute care use, keep children in school, and alleviate family burden.

Future implementation and research should focus on several frontiers. First, refining payment models through advocacy for permanent reimbursement pathways for team-based asthma education and environmental services is paramount. Second, leveraging technology through integrated digital platforms for symptom tracking, virtual check-ins with coaches, and remote inhaler technique assessment can enhance scalability and access (Kichloo et al., 2020). Third, expanding the model's scope to address social determinants of health more explicitly—by formally integrating social workers or community health workers to tackle issues like housing quality and food insecurity—will be critical for achieving health equity (Perez & Coutinho, 2021).

In conclusion, asthma is a chronic condition managed not in the clinic but in the child's daily life. The coach model, therefore, is not an optional add-on but an essential framework for effective primary care. It redefines the practice team, shifting the paradigm from "visit-based care" to "relationship-based coaching." By investing in this interdisciplinary infrastructure, healthcare systems can finally close the gap between the proven efficacy of asthma therapies and the lived reality of children and families, ensuring that every breath is not a struggle but a testament to effective, compassionate, and comprehensive care.

References

1. Adams, E. K., Johnson, V. C., Hogue, C. J., Franco-Montoya, D., Joski, P. J., & Hawley, J. N. (2022). Elementary School–Based Health Centers and Access to Preventive and Asthma-Related Care Among Publicly Insured Children With Asthma in Georgia. *Public Health Reports*, *137*(5), 901-911. https://doi.org/10.1177/00333549211032973
2. Ahluwalia, S. K., & Matsui, E. C. (2011). The indoor environment and its effects on childhood asthma. *Current opinion in allergy and clinical immunology*, *11*(2), 137-143. *DOI:* 10.1097/ACI.0b013e3283445921
3. Ancheta, A. J., Cunningham, P. B., Liu, J., Powell, J. S., Halliday, C. A., & Bruzzese, J. M. (2023). Asthma is associated with bullying victimization in rural adolescents. *Journal of asthma*, *60*(7), 1409-1417. https://doi.org/10.1080/02770903.2022.2151466
4. Belice, P. J., & Becker, E. A. (2017). Effective education parameters for trigger remediation in underserved children with asthma: a systematic review. *Journal of Asthma*, *54*(2), 186-201. https://doi.org/10.1080/02770903.2016.1198374
5. Bruzzese, J. M., Evans, D., & Kattan, M. (2009). School-based asthma programs. *Journal of Allergy and Clinical Immunology*, *124*(2), 195-200. https://doi.org/10.1016/j.jaci.2009.05.040
6. Cheng, Z. R., Tan, Y. H., Teoh, O. H., & Lee, J. H. (2022). Keeping pace with adolescent asthma: A practical approach to optimizing care. *Pulmonary Therapy*, *8*(1), 123-137. https://doi.org/10.1007/s41030-021-00177-2
7. Chew, S. Y., Leow, J. Y. L., Chan, A. K. W., Chan, J. J., Tan, K. B. K., Aman, B., ... & Koh, M. S. (2020). Improving asthma care with asthma-COPD afterhours respiratory nurse at emergency (A-CARE). *BMJ Open Quality*, *9*(2). https://doi.org/10.1136/bmjoq-2019-000894
8. Dehmer, S. P., Baker-Goering, M. M., Maciosek, M. V., Hong, Y., Kottke, T. E., Margolis, K. L., ... & Roy, K. (2016). Modeled health and

economic impact of team-based care for hypertension. *American journal of preventive medicine*, *50*(5), S34-S44. https://doi.org/10.1016/j.amepre.2016.01.027
9. Fasola, S., Ferrante, G., Cilluffo, G., Malizia, V., Alfano, P., Montalbano, L., ... & La Grutta, S. (2022). Asthma comorbidities: frequency, risk factors, and associated burden in children and adolescents. *Children*, *9*(7), 1001. https://doi.org/10.3390/children9071001
10. Ferrante, G., & La Grutta, S. (2018). The burden of pediatric asthma. *Frontiers in pediatrics*, *6*, 186. https://doi.org/10.3389/fped.2018.00186
11. Ferrante, G., Fasola, S., Cilluffo, G., Piacentini, G., Viegi, G., & La Grutta, S. (2022). Addressing exposome: An innovative approach to environmental determinants in Pediatric respiratory health. *Frontiers in Public Health*, *10*, 871140. https://doi.org/10.1080/1744666X.2022.2093187
12. Kew, K. M., Carr, R., & Crossingham, I. (2017). Lay-led and peer support interventions for adolescents with asthma. *Cochrane Database of Systematic Reviews*, (4). https://doi.org/10.1002/14651858.CD012331.pub2
13. Kichloo, A., Albosta, M., Dettloff, K., Wani, F., El-Amir, Z., Singh, J., ... & Chugh, S. (2020). Telemedicine, the current COVID-19 pandemic and the future: a narrative review and perspectives moving forward in the USA. *Family medicine and community health*, *8*(3), e000530. https://doi.org/10.1136/fmch-2020-000530
14. Kowatsch, T., Schachner, T., Harperink, S., Barata, F., Dittler, U., Xiao, G., ... & Möller, A. (2021). Conversational agents as mediating social actors in chronic disease management involving health care professionals, patients, and family members: multisite single-arm feasibility study. *Journal of medical Internet research*, *23*(2), e25060. https://doi.org/10.2196/25060
15. Laube, B. L., Janssens, H. M., De Jongh, F. H., Devadason, S. G., Dhand, R., Diot, P., ... & Chrystyn, H. (2011). What the pulmonary specialist should know about the new inhalation therapies. *European Respiratory Journal 37(*6): 1308-1417. https://doi.org/10.1183/09031936.00166410
16. Liu, W. Y., Jiesisibieke, Z. L., & Tung, T. H. (2022). Effect of asthma education on health outcomes in children: a systematic review. *Archives of Disease in Childhood*, *107*(12), 1100-1105. https://doi.org/10.1136/archdischild-2021-323496
17. Lugogo, N. L., DePietro, M., Reich, M., Merchant, R., Chrystyn, H., Pleasants, R., ... & Safioti, G. (2022). A predictive machine learning tool for asthma exacerbations: results from a 12-week, open-label study using an electronic multi-dose dry powder inhaler with integrated sensors. *Journal of Asthma and Allergy*, 1623-1637. https://doi.org/10.2147/JAA.S377631
18. McClure, N., Catrambone, C., Carlson, E., & Phillippi, J. (2020). Maximizing the role of the nurse: Strategies to address gaps in asthma care in schools. *Journal of Pediatric Nursing*, *53*, 52-56. https://doi.org/10.1016/j.pedn.2020.05.003
19. McTague, K., Prizeman, G., Shelly, S., Eustace-Cook, J., & McCann, E. (2022). Youths with asthma and their experiences of self-management education: A systematic review of qualitative evidence. *Journal of Advanced Nursing*, *78*(12), 3987-4002. https://doi.org/10.1111/jan.15459
20. Meyers, D. J., Chien, A. T., Nguyen, K. H., Li, Z., Singer, S. J., & Rosenthal, M. B. (2019). Association of team-based primary care with health care utilization and costs among chronically ill patients. *JAMA internal medicine*, *179*(1), 54-61. doi:10.1001/jamainternmed.2018.5118
21. Moonie, S., Sterling, D. A., Figgs, L. W., & Castro, M. (2008). The relationship between school absence, academic performance, and asthma status. *Journal of school health*, *78*(3), 140-148. https://doi.org/10.1111/j.1746-1561.2007.00276.x
22. Pappalardo, A. A., Martin, M. A., Weinstein, S., Pugach, O., & Mosnaim, G. S. (2022). Improving adherence in urban youth with asthma: role of community health workers. *The Journal of Allergy and Clinical Immunology: In Practice*, *10*(12), 3186-3193. https://doi.org/10.1016/j.jaip.2022.08.030
23. Perez, M. F., & Coutinho, M. T. (2021). An overview of health disparities in asthma. *The Yale journal of biology and medicine*, *94*(3), 497.
24. Phipatanakul, W., Koutrakis, P., Coull, B. A., Kang, C. M., Wolfson, J. M., Ferguson, S. T., ... & Gold, D. R. (2017). The school inner-city asthma intervention study: design, rationale, methods, and lessons learned. *Contemporary clinical trials*, *60*, 14-23. https://doi.org/10.1016/j.cct.2017.06.008
25. Pinnock, H., Noble, M., Lo, D., McClatchey, K., Marsh, V., & Hui, C. Y. (2023). Personalised management and supporting individuals to live with their asthma in a primary care setting. *Expert review of respiratory medicine*, *17*(7), 577-596. https://doi.org/10.1080/17476348.2023.2241357
26. Rylance, S., Chinoko, B., Mnesa, B., Jewell, C., Grigg, J., & Mortimer, K. (2021). An enhanced care package to improve asthma management in Malawian children: a randomised controlled trial. *Thorax*, *76*(5), 434-440. https://doi.org/10.1136/thoraxjnl-2020-216065
27. Sanchis, J., Gich, I., Pedersen, S., & Team, A. D. M. I. (2016). Systematic review of errors in

inhaler use: has patient technique improved over time?. *Chest*, *150*(2), 394-406. https://doi.org/10.1016/j.chest.2016.03.041

28. Sideridis, G., & Alamri, A. A. (2023). Predicting academic achievement and student absences in high school: The roles of student and school attributes. *Frontiers in psychology*, *14*, 987127. https://doi.org/10.3389/fpsyg.2023.987127
29. Tony, S. M., Abdelrahman, M. A., Abd Elsalam, M., Sameer Shafik, M., & Abdelrahim, M. E. (2022). Effect of using acoustic flo-tone training device and its smartphone application on enhancing inhalation technique from metered-dose inhaler with spacer in asthmatic children. *ExpErimEntal lung rEsEarch*, *48*(7-8), 224-238. https://doi.org/10.1080/01902148.2022.2113573
30. Tzeng, Y. F., Chiang, B. L., Chen, Y. H., & Gau, B. S. (2018). Health literacy in children with asthma: A systematic review. *Pediatrics & Neonatology*, *59*(5), 429-438. https://doi.org/10.1016/j.pedneo.2017.12.001
31. Vanaj, M. (2023). Closing Gaps in Asthma Care: Role of Nurse in Addressing Challenges, Barriers and Opportunities in Universal health coverage. *International Journal of Nursing Science Practice and Research*, *9*(1), 34-38. https://doi.org/10.37628/ijnspr.v9i1.2337
32. Zahran, H. S. (2018). Vital signs: asthma in children—United States, 2001–2016. *MMWR. Morbidity and mortality weekly report*, *67*.